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METHODS AND COST OF STREET CLEANING.

THE proper cleaning of streets in cities and towns is a subject now demanding the attention of all municipal officers charged with that work, and the citizens are probably giving the subject as much or more thought than the officers. We are building many miles of improved streets that might as well have been left unbuilt unless properly cared for. A wave of improvement seems to have swept into all cities, and even small towns have spent thousands of dollars to lift themselves from bad roads. Their efforts have died at this point, no arrangement having been made for the proper cleaning, so that vehicles have a better road to travel on, but the citizen has not been freed from the nuisance of mud and dust.

The present method of cleaning streets by sweeping them has proved a failure, not because the contractor does not do his duty, but because of the method pursued. The contractor follows his specification, but the specification is bad, and there is no way possible to make him do more than his contract calls for. All specifications for street sweeping call for the sprinkling of the street prior to sweeping. Water thrown on the street softens the dirt, and mud is the result. This is packed down by the sweeper, but not removed. Hardly one-half of the dust from the street can be removed by this method. If not sprinkled, the broom throws one-half of the dust into the atmosphere to settle in houses, on sidewalks, or back on the street passed over by the broom. The citizen becoming disgusted with either method tries to obtain some relief by sprinkling the street thoroughly, thus rendering it impossible for the broom to do more than plaster it tightly to the pavement.

The specifications for sweeping in Indianapolis, to which I shall specially refer, are the same as used in Washington, St. Louis and

all other large cities, and Indianapolis is as clean as any city where this method is pursued. The contract for sweeping expires June 1, 1894. The board of public works, knowing the present method as unsatisfactory, have refrained from letting contracts for the sweeping of the streets built this year, and instead have charged the city with the expense, trying different methods with the view of devising a specification that will accomplish the result aimed at —namely, "Keeping the street so free from dust at all times that none can be raised by the wind or by passing vehicles." When that result is accomplished there can be no complaint, and no necessity for damaging the street by sprinkling or causing a thick slime to be plastered over it to the disgust of pedestrians and danger to animals. This result must be attained by some method that will take up the finer particles of dust and remove them in a covered vehicle at once. Many devices have been patented with this in view, but none is in successful operation.

The method of hand-cleaning or the "orderly system" has been tried in Indianapolis for the last two months, giving results much more satisfactory than the sweeping method. Flushing with water, driving the refuse into the sewers, has been also tried, but both methods are expensive. Complete data of cost of cleaning are unattainable, and such cost would apply only to streets under the same conditions, and any estimate of cost for cleaning a street must be simply an approximation, however close, and must serve until an actual basis is obtained.

The amount of dirt carried onto an improved street from unimproved intersecting streets amounts to a considerable item, depending upon amount of travel, condition of unimproved street, whether kept muddy by sprinkling or dusty from not sprinkling. Were all streets improved a close estimate of amount of material deposited could be ascertained from the number of horses using the street.

Data collected from work done in Indianapolis may prove interesting, and will be given, but it must be understood from remarks above that such data are applicable only to the streets cleaned and to others similiarly conditioned in all respects. In presenting these data no allowance for foremen, wear and tear of hose, superintendence, depreciation of tools, interest on cost or the cost of cleaning catch basins after flushing, has been taken account of, the aim being

to give the capacity of the labor. Where prices are quoted they are prices actually paid, and will vary with locality and price of labor market. During the month of August and a part of July flushing was done by men in employ of the city, the price for labor being some higher than paid by contractors for the same class of labor. The water company supplied the water at a cost of $30 per week, with the privilege of using two streams from two fire plugs not more than nine hours out of twenty-four. The quantity of water used could not be ascertained. During the period mentioned 14,945,850 square feet of streets were flushed, making 545½ of our "squares" or blocks, equivalent to 2,973 hours of one man, or 5,094 square feet per hour per man, 443 hours for teams hauling hose, or 33,737 square feet per team per hour, and 885 hours for foreman, who worked the same as men under him, but directing it, or 16,888 square feet per hour per foreman.

From prices paid, water and labor amounted to $1,174.84; cost of water, $180; cost for labor alone per 10,000 square feet equal $0.666, or one square cost $1.82. Adding cost of water, the total would make cost per 10,000 square feet, $0.786, or per "square," $2.15, or per 10,000 square yards, $0.5993 and $0.708, respectively, *for each flushing*. A street 50 feet between curbs and one mile long would cost for water and labor alone $20.75 each flushing, and flushing once each week between April 1st and November 1st, $622.51.

Hand cleaning, or "The Orderly System," was pursued under direction of the board, wages being $1.50 per day of ten hours per man, and $3 per day for teams. The data is compiled for the month of September only: 759,706 square feet were taken care of by fifteen men, an average of 50,647 square feet per man; total hours, 5,367. Two teams were employed twenty-four days; 204 loads of dirt, averaging about 54 cubic feet, were hauled, the cost per load being $.705, and the average per team of 4.25 loads per day. These 204 loads represent the accumulations of twenty-eight days, making 7.286 loads per day, or 393 cubic feet, equivalent to 679,871 cubic inches, or a deposit of .895 cubic inches per day per square foot, or 104,260 square feet per load.

Applying data to a street one mile long and 50 feet between curbs, and allowing that such a street should be cleaned daily, and that flushing should be resorted to at least once each week on swept

streets and at least once in two weeks on streets cleaned under "The Orderly System," the cost will be as follows:

264,000 square feet, at 50,647 square feet per man, will require 5.21 men; 211 days' accumulations, or 534 loads of dirt. From April 1st to November 1st (sweeping season), 5.21 men 180 days@$1.50 per day	$1,405 80
534 loads of accumulations@$.705	376 47
Hand tools, interest on plant, renewals	23 23
Flushing 15 times@$20.75	311 25
Profit to contractor, 15%	317 50
	$2,434 25
Intersection added to property assessment	243 42
	$2,677 67

Or, in round numbers, 50 cents per front foot as an assessment against property for the season.

By present method of sweeping, cost to property is—

35 cents per 10,000 square feet each sweeping, per mile of 50-foot street	$1,663 20
Flushing once in two weeks	311 25
Intersections added to property assessment	197 45
	$2,171 90

Or, the orderly system will cost on a street of average travel, about 23 per cent. more than under present contract, flushing only once in two weeks.

I estimate the travel on streets that have been cleaned by the orderly system at 1,000 horses per day. If the orderly system is applied to streets of heavy travel the charge would be greater, as these streets are broader (in Indianapolis), and the accumulation would be heavier. From experiments conducted in Cincinnati, it was found that the accumulation amounted to 41 pounds per 100 horses.

Applying data to one square of our Washington street pavement—length 510 feet, width 80 feet, travel 6,000 horses per day—the cost for one season, flushing weekly, would be :

1 man, 180 days, @$1.50	$270 00
1 man, tools, etc	7 00
130 loads of dirt, @70c	91 00
Flushing once each week, @$3.20—30 times	96 00
Contractor's profit, 15%	54 60
	$518 60

Or, about $1.22 per lineal foot (intersection included), or 61 cents per front foot on each side. Under present contract, without flushing, the cost is $257, or about 15 cents per front foot on each side, but individual contributions from merchants to hire the street sprinkled will run the cost up greater than the orderly system, and the street is never in a cleanly condition.

In this last estimate nothing is allowed for flushing, which should be done to make the sweeping anything like effective. The orderly system and flushing should be adopted on all business streets, if we care at all for cleanliness. If the dust is removed properly, sprinkling is unnecessary, and can not be done properly as long as sprinkling is resorted to. *M. M. Defrees.*

MORRIS M. DEFREES is a successful civil engineer who has had much experience in railroad, bridge and municipal work. He has always resided in Indianapolis, and for the last three years has been a member of the Indianapolis Board of Public Works. The valuable information set forth in the foregoing article was gathered from experiments conducted in Indianapolis while endeavoring to ascertain the best method of street-cleaning.

ASPHALT AND ASPHALT PAVEMENTS.

DURING the past thirty years asphalt has been employed as the binding material or matrix for road and street coverings, laid in continuous sheets, comprised under the general head of asphalt pavements.

Since the first asphalt pavement was laid in America, which I laid in 1870, this business has grown to such an extent that now only a few cities in this immense country are without asphalt pavements.

In order to lay good pavements the quality of the matrix, or asphalt, is of primary importance, and in many instances failures are due to the inferior quality of asphalt employed in the composition of the pavement. For this reason I think it proper for me, the pioneer of the asphalt pavement, to open a discussion and investigation in regard to the required qualities of asphalt to form the best of pavements.

Bitumens of different consistencies, from viscous to hard, are called asphalts. The viscous soft bitumens are known under the

name of pis-asphalt, and the harder are simply called asphalt. All asphalts are hydrocarbons, more or less oxygenated or sulphurated. Hydrocarbons may be solid, liquid or gaseous; they are divided into divers series, which are distinguished one from the other by the relative proportions of the atoms of carbon and hydrogen. The richer in hydrogen are called saturated. The saturated hydrocarbons have no great affinity, and will not combine directly with other bodies except by substitution. They are the most staple, and therefore are desirable compounds, with some exceptions, for paving purposes.

All asphalts are partially soluble in alcohol, totally or partially in ether, and totally in chloroform and bisulphide of carbon. By the relative solubility in these solvents we gain important information in regard to the quality of asphalts under examination. Asphalts are generally composed of three different hydrocarbons: *First.* Retine. *Second.* Petrolene. *Third.* Asphaltene. The knowledge of these compounds is due to the important investigations of Messrs. Lebel and Munz.

Retine: C. 78.84, H. 10.22, S. 10.78, is soluble in alcohol; submitted to heat, it gives off hydrogen sulphuret, marcaptan, and liquid hydrocarbon, and some coke is left. This compound is not desirable in asphalt.

Petrolene: C. 80.60, H. 10.20, S. 9.20, is soluble in ether, and is the most important and desirable compound in asphalt for paving purposes, since it is the compound which gives the viscous, adhesive quality to asphalt.

Asphaltene: C. 78, H. 8.83, S. 12.89, is not soluble in alcohol or ether, but is soluble in chloroform and in bisulphide of carbon. It is this compound which gives the hardness to asphalt, and the more asphaltene an asphalt contains, the more brittle and hard it is. So an excess of asphaltene is detrimental in asphalt employed for paving purposes.

Having given a superficial description of asphalt, I will now set forth the characteristics of suitable asphalt for paving purposes.

In its natural state, and after having been refined at 400° F., it must still be compressible at 60° F.; it must be viscous and malleable at 75° F.; it must flow at 100° F., and it must have a fire test of at least 300° F. It must not contain deleterious matter soluble

in water, such as soluble salts, and the manufactured pavement must not rot or disintegrate in contact with water. It must not contain an excess of free sulphur, because uncombined sulphur in contact, at a moderately high temperature, with a saturated hydrocarbon, combines with a part of the hydrogen of the saturated hydrocarbon, which is changed into non-saturated hydrocarbon, and sulphurated hydrogen evolves. The non-saturated hydrocarbons largely undergo changes and alterations, and with good reason it may be presumed that the changes and alterations of the Trinidad asphalt are due to the action of free sulphur in the asphalt.

The hydrocarbons of which the asphalt is composed must all, or nearly all, be saturated hydrocarbons, but must not contain hard crystalline paraffine.

The asphalt must not contain over 20 per cent. of asphaltene; not more than 3 per cent. must be soluble in alcohol, and it must not yield less than 77 per cent. of petrolene, on the presence of which depends the viscous and adhesive qualities of the matrix. It must not contain a large percentage of organic matter not bituminous; it must not be soluble in caustic potash or soda. Preference should be given to the purer article, everything else being equal.

The residuum oil required for the manufacture of the asphaltic cement must not be over 13 per cent. of the pure bitumen, and the cement must have the characteristics of becoming very tough and malleable at low temperatures, when mixed with fine pulverized mineral matter, preferably carbonate of lime.

As the most important supplies of asphalt are the "Bermudez" and "Trinidad," I shall compare the several characteristics which I find in each:

ANALYSIS.

	Bermudez.	Trinidad Lake.
Specific gravity	1.09	1.377
Bitumen, soluable in C. S. 2.	97.	56.
Mineral matter	2.16 } 3.31	35. } 42.80
Organic matter, not bituminous	1.15 }	7.80 }
Soluble salts	None.	Large percentage.
Free sulphur	None.	Large percentage.
Soluble in caustic potash or soda	None.	None.
Petrolene	77.90	70.12
Asphaltene	21.08	25.63
Retine	1.02	3.25
Oil required for asphaltic cement	13.	27.
Asphaltic cement required in pavement	10	15.

	Bermudez.	Trinidad Lake.
At 60° F.	Compressible.	Hard and brittle.
At 75° F.	Viscous and malleable.	Can be slightly bent.
At 100° F.	Flowing, and can be stretched into hair-like threads.	Does not flow, but is easily bent.
At 189° F.	Melted.	Flowing.
Fire test at 300° F.	No flash.	No flash.

We thus see that out of sixteen important and necessary requirements of an asphalt, suitable for paving purposes, that "Bermudez" has eleven superior and five equal in comparison to "Trinidad Lake."

The most important points of superiority, judged from a point of quality alone, of "Bermudez" is the small amount of impurities (mineral matter and organic, not bituminous); the total absence of soluble salts and free sulphur; the greater amount of petrolene and lesser amounts of asphaltene and retine; the lesser quantity of residuum oil required to make the asphaltic cement.

E. J. De Smedt.

E. J. DeSmedt, a Belgian chemist, graduate of the University of Brussels, had studied asphalt pavement in Paris before coming to the United States in 1861. He conceived the idea, in 1869, of making a mixture of properly selected sand and pulverized carbonate of lime cemented together by suitable asphalt, the latter being first refined and tempered with heavy petroleum oil or the residuum of distillation of them. In 1870 he laid the first sample of this composition for public use in front of the city hall in Newark, N. J. In 1873 Fifth avenue opposite the Worth monument, between Twenty-fourth and Twenty-fifth streets, in the City of New York, was paved with this asphalt, and other samples of it were subjected to trial at about the same time. These pavements had given such good results that the commission appointed by Congress in 1876 to pave Pennsylvania avenue in Washington, D. C., selected, among a great number of proposals, the DeSmedt's composition, and this pavement was compounded and laid under his direct supervision. When Major Swining, U. S. Engr., was appointed as engineer commissioner of the District of Columbia, DeSmedt was offered the situation of chemist and inspector of asphalt and cements for the City of Washington, D. C. His duty was also to instruct the contractors in the manipulation and laying of the asphalt pavement as invented by him. He remained with the Washington government—engineer department—in that capacity for nine years, and resigned his position in 1887 on account of ill-health. He occupies now the position of chemist and expert for the New York and Bermudez Asphalt Company.

TELFORD vs. MACADAM. WHICH WAS RIGHT?

We may safely assume that the following requirements for broken stone roads will be accepted as standard by the majority of civil engineers now in practice:

1. An unyielding foundation.
2. Thorough surface and under-drainage is essential.
3. Material of the wearing surface a hard, tough stone.
4. The upper or surface stratum, 3 to 4 inches deep, to be composed of clean stones, broken into cubical forms nearly uniform in size, not exceeding 2½ inches in greatest diameter. The interstices between these stones should be filled with smaller fragments or clean, sharp gravel rolled in from the top.
5. On clay soils, a layer of gravel or sand 3 inches thick must be interposed between the clay and the lower layer of broken stone (except where a Telford foundation is used).
6. The materials must be thoroughly compacted by heavy rolling, and, in dry weather, this can not be effected with clean, hard stone except by thorough sprinkling. When limestone is the material used, the spalls constitute in themselves a sufficient binding course. But, where a more silicious stone is used, a layer of clean, sharp sand must be spread on top of the spalls and thoroughly sprinkled during the rolling. Even with this precaution the road surface will loosen up in some places after it is opened to the public. To remedy this the roller must be used to compact the loose places until the entire road becomes permanently hard.

Two of these requirements are:

1. Preparation of the subgrade or foundation.
2. Best method of making the broken stone covering.

Both Telford and Macadam agreed as to the necessity of thorough drainage; but the former claimed that for heavy traffic a rough pavement was required in addition. Macadam claimed that ten inches of broken stone laid according to his formula was sufficient, however soft the substratum was.

Provided we have a common understanding of what is meant by thorough drainage, the writer is on the side of Macadam in this issue. All agree as to what is meant by surface drainage; but the

requirements of perfect under-drainage do not seem to be so well understood. It is the opinion of the writer that in clay soils like those in the vicinity of Cincinnati, the following provisions are essential to success, viz:

In 24-foot roadways, lines of agricultural tile drains, 2½ to 3 inches in diameter, laid parallel to the axis of the road, 2½ feet below the subgrade and 10 feet each side of the center—*i. e.*, 20 feet apart—or 3 feet below the subgrade and 24 feet apart. In roadways 30 to 36 feet wide, it is better to have a line along the axis of the street and one under each gutter, or just back of the curb. If there is a line of sewer in the middle of the street, a line of drain tile should be laid in the bottom of the trench. The trenches having been so thoroughly rammed that there can be no subsequent settlement, the subgrade should be rolled by a heavy roller when the ground is dry. If, upon a dry clay bed so prepared, a broken stone covering of suitable depth (10 inches maximum) is properly laid, the writer claims that such a road will bear the heaviest load that will ever come upon it in ordinary practice, say not to exceed 3 tons to the wheel.

As to the preparation and spreading of the road material, the stone should be free from mud, to be crushed in a mechanical crusher and automatically screened in a revolving cylindrical screen, with holes of the following sizes: The upper section should be not less than 6 feet long, ¼ inch; second section, ¾ inch; third section, 2 inches. The dust or material passing through the first section is rejected. The subgrade is first covered with a layer of 2½ to 3 inches of screened gravel (passing through one-inch screen). On this the coarse layer of broken stone is spread and rolled lightly. In spreading this layer, care must be taken to see that the different sizes of fragments are not separated in spreading. A very little care and supervision is found in practice to ensure this result.

On the first layer so rolled, the fine layer (spalls) is spread and thoroughly rolled. The relative thickness of the two layers will vary with the kind of stone and the style of crusher used. In stone recently laid in Burnet Woods and Eden Park, they were in the ratio of 5 inches for the coarse stone and 2 inches for the spalls. The stone was from Hillsboro and broken by a Blake crusher.

A first class macadam road, even for moderate traffic, can not

be made of Cincinnati hill limestone. The amount of dust and mud formed is so great that the cost of proper cleaning and maintenance is excessive. Without constant and scrupulous cleaning, you have little better than a mud road. In fact, in dry weather, the limestone dust is more penetrating and disagreeable than that of a country mud road. The Hillsboro stone packs fairly well without sprinkling; but, of course, a moderate wetting hastens the consolidation. It is claimed that this method of road-making is superior to the traditional one in the following points:

1. It costs less. Hillsboro broken stone was delivered on the cars at Eden Park entrance at $1.30 per cubic yard.

2. The road surface made with spalls is incomparably superior in smoothness, cleanliness and hardness to that with a gravel binder.

3. The lower course, of varying sizes from ¾ of an inch to 2 inches, packs more quickly and solidly than by the traditional method.

Telford advocated the top binding course while Macadam forbade it. Hence it will be seen from the above that the writer coincides with Telford as to the top of the road and with Macadam as to the bottom. To sum up briefly, the two points which it is intended to emphasize are:

1. The bearing power of a road composed solely of perfectly dry, pure clay is ample for any wheel load that can come upon it, and it is practicable, *by capillary under-drainage*, to maintain a clay sub-grade properly covered by broken stone, in this dry, unyielding condition at all seasons.

2. Machine crushing and screening of the stone, using spalls alone as a binder.

The effect of under-drainage in increasing the load carrying capacity of clay soil has an important bearing upon the question of country roads, now so much discussed. Two lines of 3-inch drains can be laid in most soils and localities for about $1,000 per mile. Tile of this size is ample where the ground permits discharge into side drains at intervals of not over 300 or 400 feet. Where ordinary gravel can be had from streams or pits at convenient points along the line, a road covering 16 feet wide and 6 or 8 inches deep properly solidified by rolling should not cost under most favorable conditions more than $1,000 per mile. Such a road could therefore

be made, including surfacing and rolling the sub-grade, constructing the necessary side drains, etc., for $2,000 to $2,500 per mile. This, of course, would not provide bridges or culverts, nor any considerable amount of grading. But there are, especially in the Mississippi valley, large areas of level or gently undulating country to which the above conditions would apply and in which there is sufficient population and capital to justify this amount of outlay.

It seems to the writer, that if the Road Congress at Chicago had prepared a section of such a country road, with the view of showing especially how good a foundation can be made by simply underdraining the sub-grade, and how heavy a load a 6-inch layer of gravel or broken stone will support on such a foundation, a marked advance would have been made in overcoming the prejudice of farmers against better roads.

In many localities a 12-foot roadway with 6 inches of metal and a single line of under-drains, will answer the purpose. Such a road could ordinarily be made for $1,200 to $1,500 per mile.

Latham Anderson.

STREET-PAVING IN AMERICA.

[Extracts from an article in the October number of the *Century Magazine*. By permission of the editor of the *Century*.]

SOME understanding of what is involved in the problem of better streets may be drawn from the statistical information found in the census of 1890. It is only in American cities having a population of more than 10,000 that less than one-third of the total length of streets has been paved in any manner. If the construction of new pavements on the remaining 24,838 miles of streets in such cities proceeds as rapidly as now seems probable, the expenditures for this work in the next ten years will aggregate upward of a billion dollars. It is doubtful if more than sixty per cent. of the streets of these cities would then be well paved.

From a well-paved street abutting real estate derives an increased value, hardly ever less, and often many times more, than the cost apportioned to it. It is, therefore, right that abutting property should, as it does in most American cities, bear the cost of the construction of a pavement, which becomes at once a substantial improvement, having a salable value, on which the property-owner alone can realize. The benefits are shared to some extent by adjacent property which may not abut on the street, but it is doubtful if a fair and practicable apportionment of the cost could be carried beyond the border line, though the justice of this restriction is almost intolerably strained when one paved street is compelled to bear the travel that would pass over others if put in equally good condition.

* * *

The common mistake of regarding the cost of a street pavement as a merely luxurious expense rather than as a profitable improvement, has, more than anything else, deterred the work of putting the roadways of our American cities and towns in proper condition, and, it should be added, has hindered progress and prosperity immeasurably. It has also had a mischievous influence, when coupled with false ideas of economy, in causing mere cheapness in cost to become with a deplorably large number of people the main desideratum when they find that paving can not longer be deferred. A

record of the failures that it has inevitably led to, since the beginning of experiments in road-making, would tell about all of the history of paving that is worth knowing.

* * *

The common objections to granite-block paving are the nerve-rasping noise caused by contact with it of hoofs and wheels; its slipperiness, resulting from wear and water; the resistance to traction from its uneven surface; and the receptivity of dust and foul substance in the interstices between the blocks, which also are the weakest part of the surface, on account of the difficulties of filling and cementing them sufficiently. And yet these joints are some protection against slipperiness. One of the best granite-block pavements in America was some years ago laid on Westminster street, in the city of Providence, Rhode Island, on a concrete foundation, with the interstices between the blocks compactly filled and cemented, thus making an even surface which could be easily cleaned, and did not permit the accumulation of filth and dirt usually found in the joints of such pavements. It seems improbable, however, that any method of construction can make stone-block paving generally desirable; and in America, as in many of the principal European cities, its use is likely to be restricted to streets where there is much heavy travel. In none of the large cities is it in growing demand equally with other commonly approved kinds of paving.

* * *

Wood has been tried as a paving material in many ways, varying from simply laying thick planks on the level earth of roadways, as may still be seen in some towns where the soil is sandy, to the more ingenious methods of block construction. It was long believed that there were qualities in wood of some kind which, by some process of treatment, as well as by some manner of use, could be made serviceable in a superior degree in paving; and how tenaciously this idea was adhered to is indicated by the many experiments made for a brief time with some success. The qualities of the material seem to have undergone all conceivable tests within the range of science, and the methods embrace about all the variations of practicable construction, including, to some extent, combinations with other materials, with results which have demonstrated that the simpler forms are the better.

The kinds of wood most largely used in America are pine, cedar,

cypress, and oak, a choice between which is determined in different localities by convenience of supply rather than by superior quality. If from two to five years' longer service is preferable to lower cost, the wood having the greatest density and toughness should be used.

Attempts to protect blocks from decay, and to prolong their durability, by subjecting them to processes known as mineralizing or creosoting, or by boiling them in oil, or covering them with compositions of tar and other substances, have not been conspicuously successful; on the contrary, there are doubts as to their utility, as blocks which have undergone such treatment, when examined after having been long in use, have shown no other effect than mere discoloration and a closing of the fibers of the wood, which seemed to have hastened internal decay. The cylindrical and rectangular forms of blocks are most approved: the former from 8 to 10 inches in diameter and 7 inches deep; the latter 4 inches wide, 5 inches deep, and 8 inches long.

The most important considerations in methods of laying the blocks are the foundation and the joints. Early failures of wood pavements laid on sand and gravel were attributed, doubtless correctly to a great extent, to the character of the foundation; and experiments which aimed to remedy this defect brought into use in various ways planks from 1½ to 2 inches in thickness for a sub-pavement. Much stress was put upon the desirability of having an elastic as well as a uniformly solid foundation, and sand was spread over the layer of planks to a depth of two inches or more, making what was called a cushion. The same material was by some also placed under the planks, and others used a sub-course of gravel or broken stone. As a means of giving greater firmness to the pavement, and preventing the displacement of blocks, wooden wedges, held by a groove in the foundation planks, were, in one system which was in favor for a time, placed between the parallel rows of blocks, reaching to within about three inches of the surface, the remainder of the open space being filled with gravel and tar. Finally, hydraulic cement concrete, with a top layer of sand as a cushion, came into use, but it has had reluctant acceptance on account of its increased cost, and, therefore, the plank foundations are still preferred for wood-block paving, most extensively, how-

ever, in cities of the south and west. Attempts to protect wood by chemical treatment from the damaging effects of water have been supplemented by a method of laying roofing felt under the blocks, and inserting it in the interstices between them for the purpose of absorbing moisture. The theory that led to the adoption of this system, which has distinct recognition, was that expansion and contraction, under variable atmospheric conditions, were the principal causes of the early failure of wood-block pavements. Water has always been recognized as their unconquered enemy. Experience has demonstrated, however, that no better protection can be afforded than by methods which facilitate drainage.

It is often asserted by persons who argue against wood-block pavements that the destructive tendencies of their absorption of liquids are also objectionable because they develop processes of fermentation and decay, which produce unsanitary conditions. As a theory this is too plausible to be disputed, but an attempt to verify it by a comparison of the mortality statistics of cities largely paved with wood blocks, and those having other pavements, is disappointing. The destructible character of wood, however, renders it one of the least durable materials, and experience indicates that satisfactory service can not be expected from it for a longer period than ten years; but, notwithstanding its deficiency in wearing qualities, it continues to share in public favor in some of the principal European cities, chiefly because its surface is easily tractive, and at the same time is neither so hard nor so slippery as some other pavements, while it is also less noisy.

* * *

During the last fifteen years, interest in what is commonly known as the sheet pavement, made of materials combined in the form of a mastic, has been rapidly growing in America. It is the most completely distinct modern product of experimental paving; its chief advantage over the block system being a surface of unbroken smoothness, which offers little resistance to traction. The different compositions numbering fifteen or more, used in this system of paving have been indiscriminately identified by the public with asphalt, which, though introduced in small proportions, is an essential part of the standard formula. All sheet pavements, however, can not be properly called asphalt pavements; for asphalt

is not used at all in some of the compositions, and those which are technically designated by the name in America, in discriminating between the different kinds of mastic, are only successful imitations of the original and genuine asphalt pavements, as laid in Europe, where asphalt first attracted attention as a material suitable for paving in 1849.

* * *

Attempts to produce a mastic which would be an acceptable substitute for the European asphalt rock have encumbered the streets of American cities with various kinds of worthless compositions. Coal tar, pitch, and rosin, used as cementing substances, have been combined with sand, gravel, ashes, lime, sawdust, and other materials, in what have been represented in some instances to be asphaltic mixtures; but most of them have soon failed under the wear of travel and exposure to the weather, the evaporation of the volatile oils being quickly followed by disintegration of the remainder of the composition.

Mr. E. J. De Smedt, a Belgian chemist, who had studied asphalt pavements in Paris before coming to the United States in 1861, conceived the idea in 1869 of making a mixture of silicious sand and pulverized carbonate of lime, cemented together by Trinidad asphalt, the latter being first refined and tempered with heavy petroleum oils or the residuum of the distillation of them. In 1870 the first Trinidad asphalt pavement was laid for public use in front of the city hall in Newark, New Jersey. In 1873, Fifth avenue, between Twenty-fourth and Twenty-fifth streets, opposite the Worth monument, in the city of New York, was paved with this composition, and other samples of it were subjected to trial about the same time; but there was little demand for it until after Pennsylvania avenue in Washington had been partly paved with it under the direction of a special commission appointed by Congress in 1876. Hundreds of miles of it are now in use on the streets of American cities.

Asphalt is not, as may be supposed, used in large proportions in the composition. Merely enough of it is introduced to cement the other materials. The mixture of the refined Trinidad asphalt and the residuum of the distillation of petroleum oil is known as "asphaltic cement," which constitutes from ten to fifteen per cent.

of the paving composition, the rest of which is fine sand and from three to five per cent. of pulverized carbonate of lime. Slight changes in the formula are made to suit differences of climate.

* * *

The American sheet pavements, in comparison with those of Europe, are not deficient in tractive or sanitary qualities. Their worst faults are shown in tendencies of the mastic composition to disintegrate in places where the surface soon wears away, or in eruptive disturbances, which may result from improper use of materials, as well as mistakes or carelessness in work. To these causes oftener than to the effects of wear the failure of sheet pavements in American cities can be traced; and as the difficulties of doing all of the work with the requisite exactness and uniformity seem to be to some extent unavoidable, the only safe assurance of durability is an adequately protected guarantee, at the time of construction, that they will be kept in good condition for a fixed period of time.

Some of the common objections to the asphaltic pavements are the clicking noise of hoofs striking upon them, the easy raising of dust from them by passing winds, and their slipperiness when wet. In considering these objections, the thought will doubtless come to the reader that sprinkling will allay the dust, but will at the same time increase the danger of accidents from the slipping of horses. The slipperiness about which so much complaint has been made, however, is a characteristic of the asphalt pavements of Europe more than those of America, due to a smoother surface and to the limestone in the former, which do not afford as good a foothold as the sand composition of the latter, though official statistics from American cities indicate that a slightly larger number of accidents result from slipperiness on asphaltic than on other pavements.

* * *

Within the last five or six years, in the smaller cities of the Western and Middle States, there has been a demand for brick as a paving material, which has grown more rapidly than the facilities for supplying it. The experiments with it, conducted professedly without knowledge that it long before had been used for such purposes in Holland, are traced back to the year 1870, when it was first tried in the United States as a street paving material in Charleston,

West Virginia, at about the same time that the first sample of Trinidad-asphalt pavement was placed at the service of the public in Newark, New Jersey. While the growth of the two systems in public favor has been contemporaneous, in only a few of the larger cities have they been brought into rivalry in any degree, largely because the promoters of each have not found their most tempting opportunities in the same fields. The experiment at Charleston grew out of an idea conceived by Dr. John P. Hale, of that town, that bricks which had been compressed and burned to unusual hardness for use in the construction of a house which was being built for him, would be a good substitute for broken stone as a street paving material. When Dr. Hale explained his idea to the common council of Charleston, it was pronounced absurd by many of his fellow-citizens; but, as he proposed to bear the expense of the experiment, he was given permission to lay, according to his own plans, a sample of brick pavement on the busiest street in the city. The people of Charleston, contrary to their expectations, found that the new paving material, instead of being crushed into pieces in a month, had durable qualities. Since 1873 the demand for it there has been exclusive, and it is now in use on several miles of streets.

* * *

The manufacture of what are known as paving brick has within a few years become a distinct industry, which has already grown into large proportions, requiring millions of dollars of capital in its operation. Chemical discoveries, aided by improvements in machinery, have made it possible to produce, from some kinds of clay, brick which rival granite in hardness; yet the industry is probably in the infancy of all its possibilities. The advancement has been rapid, however, during the time that attention has been directed to it; the brick made ten years ago withstood a pressure of from 500 to 4,200 pounds per square inch; some are made now which withstand a pressure of 22,000 pounds per square inch. Clay unlike that ordinarily used for building brick is required; it should be vitrifiable, with qualities capable of certain chemical affinities. The better paving bricks are made from shale clays, which in some places are mined at a depth of about 300 feet in the earth, and in other places are found on the surface. In the crude state these clays are much like stone. In the process of converting them into

brick they are pulverized by machinery into a fine powder, which, when mixed with water, becomes a plastic mass, capable of being molded into any of the various forms made for paving purposes. Some blocks are much larger than the ordinary brick, and are intended to afford peculiar advantages, either in the character of the surface or in durability; but experience has led to a preference for brick of about the same shape and size as those used for building purposes, mainly for the reason that they undergo the heating process to which they are subjected with more thorough uniformity than the larger blocks. This process usually continues for about ten days at from 2,000 to 3,000 degrees Fahrenheit. If the clay does not possess the requisite qualities, it will fuse under heat that will produce vitrifaction, and the bricks will be useless.

Paving brick should have a degree of density and compactness which will preclude as much as possible the absorption of moisture, together with the strength derived from combined toughness and hardness, which will enable them to bear great pressure without fracture, and at the same time to resist abrasion; in short, they should have, as nearly as possible, the qualities characteristic of granite, with which, indeed, very favorable comparisons may be made, as shown by tests of samples of brick now produced at many points in the Middle States, where the industry seems to be most favored by natural conditions. These tests, applied by various mechanical processes, are employed by many municipal engineers in endeavoring to determine the qualities of brick offered for paving purposes, and while they should not be regarded as conclusive, they certainly have some indicative value. Tests of samples of brick may, however, indicate a degree of durability which could not be realized from their use in a pavement; besides, samples nearly always have better than average qualities; and it is pertinent to add, also, that one of the great difficulties with brick paving is to secure uniformly good quality in the material, owing to the impossibility of producing it in the processes of manufacturing.

The durability of brick, which is unquestionably its best quality, has not yet been demonstrated sufficiently to warrant any manner of suggestion that it may be advantageously substituted for granite where the requirements of service are extraordinary. Experience has been comparatively favorable to it, however, in the

smaller cities, on streets bearing moderately heavy traffic, but not without some exceptions, where, owing to defective materials, it proved disappointing. It has been tried in only a few of the larger cities, and in those to a limited extent; but within the last six years a popular demand for it, attracted by its comparative cheapness and durability, has brought it into use in more than 200 of the towns and smaller cities most accessible to the points where paving brick manufactories have been located. In some towns the pavements are without foundations other than a spread of gravel, sand, or coal cinders, and the most common forms of base are a layer of broken stone six to eight inches in thickness, of planks, or a sub-course of brick, each covered with sand; concrete is rarely used.

* * *

To pave is regarded as a duty to the public. When paving is done, correlative duties are imposed on the public; the pavement which is placed by its command, or voluntarily provided for its benefit, it should protect. Municipal power may be rightfully and helpfully exercised in requiring that the wheels of vehicles shall have tires ample in width to bear the loads upon them with the least wear of the surface of a street. Protection should be given also against abuses of corporation franchises permitting the tearing open of street pavements for the purpose of laying or reaching gas, water, and steam pipes, electric wires, and other underground systems. In many of the streets of our larger cities these now constitute a network which should be combined in subways. Openings in pavements for excavations below the foundation are damaging beyond complete repair, and, if numerous, will be ruinous. In some of our best governed cities it is wisely and rightly required that all desired connections between adjacent property and underground street systems shall be made before the construction of new pavements begins; and, after the work is completed, openings are not permitted to be made, except in cases of extreme necessity, and then only by special authorization. *William Fortune.*

CURRENT INFORMATION.

PUBLIC WORK IN CHATTANOOGA.

The report of the board of public works of Chattanooga, Tenn., for the last fiscal year, reviews the work done under their direction in the expenditure, since they came into power, of $125,000 for sewers and $500,000 for street paving. In establishing uniform grades on the streets they have encountered considerable difficulty. Under the laws of the state the property owners are allowed damages for changes of grade, and many took advantage of this, among the number some whose property was largely benefited by abutting street pavements put down at the public expense. Another of their difficulties is explained as follows:

"On all streets paved a vast quantity of curbing was found to be unfit for use on a permanent street, and as the law does not allow the corporation to force property owners to replace curbing once it has been accepted by the city, the board had to supply an enormous quantity of new curbing. All old curbing had to be redressed and reset, so that the item of curbing alone, because of the existing laws, cost the city in the neighborhood of thirty thousand dollars. On some streets it was possible for the city to cajole and persuade property owners to supply new curbing when the old was deficient, but in most cases all efforts to secure such agreements failed. In some cases the city was required by exacting property owners to grade and relay sidewalks before they would permit the work of public improvement to proceed. But notwithstanding the vexatious obstacles this board feels that it has secured for the city of Chattanooga, so far as it has been able to go, the best thoroughfares and at the smallest possible cost, of any city in the country. The prices for the work done is much below that of most cities and is in excess of that paid by none."

The report of City Engineer Hooke shows that Chattanooga now has thirteen miles of permanently paved streets, of which three miles were constructed during the last year. Their asphalt pavements are put down by the Warren-Scharf Company, under a guarantee of ten years. The crown given the asphalt pavements is six inches for a roadway of thirty feet, and seven and one-half inches for one of forty feet in width, "the quick flow of the water to the gutters being even more desirable in the case of asphalt than it is with brick, for water is an agent that operates injuriously on the asphaltic mixture, and its presence on the surface of the pavement should be gotten rid of as promptly as may be practicable. It is therefore important that the inclination of an asphalt pavement, both transversely and longitudinally, should be sufficient to insure the prompt drainage of its surface."

The city has put down more brick paving than any other kind. The brick used was manufactured at Robbins, Tenn., from a shale found in that vicinity. They are laid on hydraulic cement concrete foundations. They were laid on grades as steep as eight and one-

half and eight and three-fourths per cent., but City Engineer Hooke recommends that the grade for this kind of pavements should not exceed six per cent. Referring to the use of concrete foundations for all permanent pavements, Mr. Hooke says: "It is well understood, or ought to be, that the stability, and, therefore, the success of every permanent structure, whether it be a bridge designed to support a rapidly moving railroad train, a city building in which is stored valuable merchandise, or containing, it may be, hundreds of human lives, or whether it be simply a street pavement, over which hundreds, or possibly thousands, of vehicles pass daily, are dependent on the strength and stability of the foundation which support it. Though the consequences resulting from the failure of the last named structure might not prove so serious as they would in the case of the failure of either of the other two, the truth of the proposition is no less apparent whether applied to the one or the other.

"If a soil upon which a pavement is to be laid is of a hard and unyielding character, and can be maintained in that condition after the pavement is laid, then no other foundation would be required, and if the material to be used in the pavement is in the form of blocks, nothing additional but a bed of clean, sharp sand spread over the soil, after the latter has been properly graded, would be needed beneath the pavement. But as soil of the required degree of stability is rarely found, particularly in cities where it has been so frequently disturbed by pipe layers and others, the introduction of an artificial foundation is usually of the highest importance. There are several kinds of artificial foundations, namely: Cement concrete, consolidated broken stone, rolled gravel, and, in the case of brick pavements, a course of bricks laid flatwise on a bed of sand, and lastly a foundation, if it can be so called, of simply sand deposited on the soil for a depth of six or more inches.

"As the object of all artificial foundations is to cause to be distributed over as great an area of soil as practicable any weight that may be brought to bear upon a limited area of pavement, it is clear that the foundation which shall fulfill this requirement in the highest degree must be monolithic in character, and extending across the roadway from curb to curb. Such is the character of the foundation constructed of a mixture of broken stone, sand and hydraulic cement.

"While on streets of light travel, those that are not now important thoroughfares, nor likely to become so in the near future, a gravel foundation may be used in some cases, or, if the soil is reasonably hard and compact, the pavement may be laid simply on a sand form, a more stable foundation is required on the important avenues of travel, and this city will, I think, never have cause to regret the use of concrete for the foundations of the pavements laid during the past three years under the direction of the board of public works, for the streets which have been paved are either important thoroughfares now or such as are likely to become so in the near future."

Chattanooga now has twenty-five miles of pipe and nine miles of brick sewers. This has all been constructed since 1880. The system was originally devised by E. S. Chesbrough, a former engineer of Chicago.

WORLD'S FAIR CONGRESS ON GOOD ROADS.

The congress on good roads, held in Chicago, October 17–20, under the auspices of the congress auxiliary of the World's Columbian Exposition, brought out much information bearing on the movement for better highways. The sessions were presided over by Mr. Theodore Butterworth, of Chicago. The programme embraced addresses as follows: "Road Engineering and Construction," Professor L. M. Haupt, of Philadelphia; "Road-making in the South," Professor C. Morton Strahan, of Athens, Ga.; "Road Drainage," J. J. W. Billingsly, editor of *Drainage Journal*, Indianapolis; "Roads of Russia," A. Grineosky, Imperial Russian Commissioner-General to the World's Columbian Exposition; "Good Roads, Organization, State, County and Town Action," John A. C. Wright, Rochester, N. Y.; "Roads in the West," Charles P. Chase, Clinton, Ia.; "Good Roads," Col. Albert A. Pope, Boston; "Convict Labor," B. D. Lumsden, Macon, Ga.; "Free Turnpikes," J. M. Heiskell, Memphis, Tenn.; "Some Defects of State Roads Improvement Laws," William Fortune, Indianapolis; "Country Roads," M. W. Stevens, Kingston, Wis.; "The Relation of the Agricultural Colleges and Experiment Stations to Road Improvement," D. E. Lautz, Manhattan, Kan.; "The Roads in Wisconsin," A. A. Arnold, East Side Farm, Wis.; "Roads in New Jersey," F. A. Dunham, Hornellsville, N. Y.; "Road Construction," H. Irwin, Montreal, Can.; "Good Roads," Jed Lake, Independence, Ia. Nearly all of the addresses advocated new methods, organized work in better enlightening the public as to the importance and benefits of better highways, and changes in the existing road laws. The sessions were attended by a number of the men most prominently identified with the movement for good roads, including, in addition to those who delivered addresses, General Roy Stone, vice-president and secretary of the National League for Good Roads; Dr. Chauncey B. Ripley, of New Jersey, and Judge E. H. Thayer, president of the Iowa Highway Improvement Association. The proceedings of the congress, including all addresses in full, will be published under the direction of the World's Fair Auxiliary.

HIGHWAY LEGISLATION.

The executive committee of the National League for Good Roads, at a special meeting in Chicago, October 20, appointed a committee on legislation, with instructions to make a thorough inquiry into the subject with a view to submitting a report which may be made the basis of legislative action in improving the road laws. The committee is composed of Dr. Chauncey B. Ripley, of New York, John A. C. Wright, Rochester, N. Y., A. C. Mathis, Chicago, and William Fortune, Indianapolis. The headquarters of the National League for Good Roads will hereafter be in Washington, where Gen. Roy Stone, the vice-president and secretary of the League, is directing an inquiry relating to good roads under authority of the Secretary of Agriculture.

HIGHWAY IMPROVEMENT IN MASSACHUSETTS.

The new law under which the Massachusetts highway commission will undertake to improve the public roads of that state is a new departure in legislation relating to highways which will be watched with great interest throughout the

country. It is framed in accordance with recommendations from a commission appointed for preliminary investigation, which devoted several months to inquiry into the needs of the state in the way of better roads and how improvement could be best brought about.

Among other duties the commission is required to compile statistics relating to the public roads, and furnish information or advice to officers of counties, cities or towns relative to the construction, repair, alteration or maintenance of roads. They shall prepare maps for public use showing the location in the state of road-making materials.

They are also required to hold at least one public meeting annually, in each county, for the open discussion of questions relating to the public roads.

Whenever the commissioners of the county adjudge that common necessity and convenience require that the commonwealth acquire as a state highway a new or an existing road in that county, they must present the matter by petition and writing to the state highway commission. It is left with the commission to determine whether the improvement shall be undertaken, but an appropriation must be made by the legislature before the road can be constructed.

Cities and towns have the right to contract with the commission for the construction of highways lying within their limits. All contracts made by the commission are subject to the approval of the governor and council. Cities and towns are given police jurisdiction over all state highways, but are required to notify the commission of needed repairs. No one may dig into the roads for any purpose without permission from them.

While the law has good features, it seems to be impracticable in some respects and is open to the objection that it is likely to unnecessarily hinder or delay needed improvements.

The commission is composed of Geo. A. Perkins, N. S. Shaler and W. E. McClintock. Their office is in the Smith building, Court-square, Boston.

CHICAGO'S PROPOSED INSULAR PARK.

An insular park system, consisting of an island or group of island parks in the lake, within a few minutes ride of the boat landing is one of the late projects discussed in Chicago. Ways are being devised with which to provide the necessary funds. In answer to a reporter's question as to how the money for the purpose could be raised, ex-mayor Hempstead Washburne, a warm champion of the plan, says:

"There was never an acre of land bought in this city for park purposes that did not arouse bitter opposition, and the public-spirited men who projected the several parks were subjected to violent abuse. Future generations would bless the men who could push to a successful conclusion a project for the creation of an insular park system for Chicago. I should go on the theory that the islands are a necessity and should be built. Then I should exhaust every means to have the city or park boards build them. If, on account of the hard times or because it is felt that the safe limit of taxation has been reached, the authorities should be urged to let the work be done under proper restrictions by private enterprise, the persons building them to reimburse themselves by being given restaurant and amusement privileges, the island to revert to the people

absolutely at the end of fifty years or before if the revenue is sufficient to pay for the cost and a reasonable interest on the investment. The island, if built by private capital, should be under municipal or park control and every restriction insisted upon for the protection of the public interests. The people should have free access to the islands, but they should not expect special privileges in the line of food, drink or amusement without paying for them. Provisions must be made for income to pay interest on the money invested, and the tax imposed need not be greater under private occupation than under city ownership."

"Do you think private capital could be enlisted in such an enterprise?"

"Yes. It looks like a safe business proposition, and I would not look for trouble on that account. Mind you, I am only suggesting the building of the islands by private enterprise as a last resort. It would be infinitely better for the public to build and own them without entering upon alliances of any sort. But I want to see the islands built."

A NEW WATER FRONT FOR NEW YORK.

A plan to make new land and a new water front for New York has been completed by Arnold Ruge, who proposes to bridge North and East rivers, extend Manhattan Island toward the south by means of an artificial peninsula two miles in length, and have the new bridges meet on Governor's Island, which will become a part of the peninsula. Mr. Ruge's estimates for cost and profits are as follows: East river bridge, with ten tracks, $15,000,000; Giant bridge, with fifteen tracks, $50,000,000; approaches to bridges, $5,500,000; engineering, incidentals and interest, $16,000,000; cost of making new land, $26,450,000; total, $112,950,000. Value of new land and new water front, $199,120,000; profit to the city, $186,170,000.

MILWAUKEE'S FIRST ASPHALTIC PAVEMENT.

The first section of asphaltic pavement ever laid in Milwaukee was Jefferson street, which was completed during the latter part of September. The event was ceremonious, the newly paved street being formally opened by the mayor and city engineer, who drove over it in their carriages. General satisfaction is expressed with its smooth surface, giving those who drove over it, using their own words, the first smooth ride they had ever experienced in their own city. The paving problem is one to which much time and space has been devoted in Milwaukee, and it now seems to have been almost solved. The legislature passed a bill last winter authorizing the city to apportion the payments of street improvements to adjoining property owners, into three annual assessments instead of one. The bill was passed with a view to introducing asphalt streets in Milwaukee. The business streets are now paved with cedar blocks and granite, and the roadways are of gravel, of such excellence that the matter of paving any but the business sections of the city was, for a time, uncertain. Cedar block had the preference with a few because it was so cheap, that after being renewed two or three times they claimed it would not be more expensive than the first cost of more durable kinds of paving. Granite block, while favored for its durability, was criticised for its noise.

TOP DRESSING OF ROADWAYS.

According to the Bridgeport (Ct.) *Standard*, Mr. S. W. Beers, president of the board of public works of that city, has been advised by officers of the Chicago street department that trap-rock, such as is used in Bridgeport and other eastern cities, is not suitable for the top dressing of streets. In reporting this information, the *Standard* says: "When softer stone is used on roadways, they said, better results are obtained. When the top layer of loam and sand is worn through by constant travel the stones are reached. If the stone is not too hard it is worn off by passing wheels, and the fragments thus broken off fall into the crevices, making the bed of the road solid and compact, and more durable than ever. On the other hand, if the stone is very hard, like trap-rock, the streets will need constant attention. As soon as the top layer of loam and sand is cut through, and a passing wheel strikes a hard stone, instead of breaking off a small portion, it loosens the stone and probably forces it up on the roadway. Then another is quickly forced out of place, and soon the roadway is strewn with loose stones, which are dangerous for horses passing through the street. Mr. Beers appreciated the force of this argument, because he knew such to be the case in this city. Men are constantly employed here collecting loose stone from the streets. This material is removed to other streets and there used for top dressing purposes."

A MORE RATIONAL PRESENTATION OF THE CALCULUS.

At the regular meeting of the association in Nashville, Tenn., Oct. 12, Prof. W. W. Carson, of Knoxville, Tenn., presented a paper entitled "A Plea for a More Rational Presentation of the Calculus." The beginner in the calculus finds the continuity of mathematical science broken, and instead of the characteristic clearness of proof, he is surrounded with perplexity and darkness. Prof. Carson investigates the causes of this condition of affairs and proposes a remedy. The demonstrations of the calculus of to-day rest either on Limits or on Infinitesimals, or on both. The former proves the formulas, without giving any foundation or any explanation of the nature of the calculus; the latter explains, without proving, yet, as it leads directly to true results, it is accepted. Proofs by limits, when sifted down, rest on slippery definitions and ambiguous language; infinitesimals are invested with the property of changing their magnitude from the considerable to the inconsiderable as occasion demands. Prof. Carson repudiates the doctrine of infinite quantities, both infinitely great and infinitely small; such a classification is artificial and useless. The equations of the infinitesimal calculus are false to him who understands the dx's and dy's to stand for infinitesimal increments, though true to him who understands them to stand for something else, and it is by performing the operations of the latter's conception that true results are reached. Instead Prof. Carson would introduce *hypothetical* quantities. A real occurrence takes place by the continuous change of conditions, and in a real magnitude the conditions are different for the different parts; the hypothetical quantity is what we suppose would exist under a reduced number of conditions actually obtaining in the real quantity; hence is simpler than the real. The calculus is de-

fined as "that branch of mathematics which connects real and hypothetical quantities." The problem of the different calculus is given the real quantity, to find the hypothetical; that of the integral calculus is given the hypothetical quantity to find the real. The investigator desires to find a certain real magnitude, which, by reason of the complexity of the conditions, is beyond the reach of his other mathematics; he turns to the hypothetical and considers another magnitude, similar in nature to the real and that would exist if the conditions were less complex; if this simpler magnitude is within the reach of his mathematics, he passes, by the rules of integration, to the real; otherwise the process of the hypothetical is repeated until conditions sufficiently simple are arrived at, after which, by the proper number of integrations, the real is reached. With this conception of hypothetical quantities are logically derived those equations gotten by the limit calculus, and what its "derivatives" really are is shown; multiplying these equations through by dx gives the equation used in the infinitesimal calculus.

The association will next convene at the annual meeting in Nashville, Nov. 9th.

WALTER G. KIRKPATICK, *Sec'y.*

TRAMWAYS IN CAIRO.

Consul-General Penfield, at Cairo, reports to the State Department that the Egyptian government has decided to authorize the establishment of a system of tramways in Cairo and its environs. "The introduction of tram lines," he says, "would improve to a great extent the methods of transportation and communication in Cairo, and, if demonstrated a public convenience, a similar concession for Alexandria would doubtless be early decided upon.

"The matter is already attracting the attention of European capitalists and engineers, and it may safely be predicted that there will be some competition to secure the franchise.

"The permanent population of Cairo is roughly estimated at 500,000, of which 30,000 are Europeans. In the winter season the latter figures would be greatly augmented by the influx of travelers."

He ventures the opinion that American electrical engineers could furnish a system of traction comparing favorably with any that will be submitted by Europeans.

MASSACHUSETTS HIGHWAY ASSOCIATION.

The Massachusetts Highway Association will hold five meetings during the next year, as follows: November 13, 1893, February 13, May 8, August 14, and November 13, 1894. The association now has about one hundred members, and it has done much good work. The officers are: President, William E. McClintock; vice-presidents, L. B. Stone and William L. Dickinson; treasurer, Samuel S. Merrill; secretary, Charles R. Cutter; directors, H. H. Carter, L. B. Walker, R. E. Crowley and A. B. Drake.

METHODS OF HEATING STREET CARS.

At the American Street Railway Convention, held in Milwaukee last month, an interesting report of the committee on heating and lighting street railway cars was submitted by Mr. G. F. Greenwood, who gave the results of some investigations and his own experience in heating and lighting cars. Mr. Greenwood, treating the two subjects separately, says:

"Considering street railway car heaters in the manner in which the fuel is converted into heat, we can divide them into three classes:

"*First.* Primary heaters, or those in which the heat is obtained from fuel consumed on the car.

"*Second.* Secondary heaters, or those in which the heat is generated beyond the car and transmitted to some storing medium.

"*Third.* Electric heaters are those of three conversions.

"In cable railway practice we are limited to the first two heaters. In electric railway systems we have the choice of one of the three classes, therefore we must consider the means employed to propel the cars, the type of cars, the physical conditions of the railway, and the cost of various kinds of fuel. The elements of climate, distance and system are considered only secondary in this paper, as these have but little effect in the decision as to which is the best heater. We also have to consider the element of pleasing those for whom we heat the cars, and this last will, to a certain degree, govern the adoption of one form or another, provided the difference in operating cost is not too great.

"First method: I have included in this class all stoves, oil burners and hot air heaters. There are many devices on the market for accomplishing a method of heating directly from coal or other fuel burned on the cars. These can be divided into three classes as follows:

"Heaters fired from inside the car above the floor.

"Heaters fired from inside of car under the floor.

"Heaters fired from outside of car.

"If we decide on a heater of either of these classes, would suggest using the one that is complete in itself, which occupies as little room as practicable, one that can be fired and operated from the inside of car, and that uses anthracite coal for fuel.

"Hood heaters of this description can be purchased at from $15 to $24 per car, and can be installed at a cost of about $1.50 per car.

"The cost of operating heaters of this description per car per day of eighteen hours is given in the following table:

"Fuel, anthracite coal, at $4.75 per ton. Labor, at $1.50 per day. Maintenance, twenty-five per cent. of the cost of stoves, this makes cost per car per day:

"Fuel,	8.7	cents,
"Maintenance,	3.8	"
"Labor,	3.0	"
	or 15.5	" per car per day as an actual cost of operating stoves.

"Second method: In this class there are two types, one using steam and the other water. In the first type steam is used to heat earthenware cylinders or tubes placed in iron pipes, and in the others, heated water is forced into radiating tubes in the cars. These iron tubes or radiators are placed along under the seats, with pipes leading through the floors, to the outside, where some form of steam or water coupling is provided. At the charging station a rubber hose, connected either with steam boiler or with hot water supply, is equipped with some form of valve.

"Third method: Electric heaters.—These are constructed of wire or other electrical conductors placed in and around a non-combustible material, and the heat is generated by raising the temperature of wire by current taken from the power station of the road. The amount of heat produced in these heaters is

proportional to the amount of current used. These heaters, usually four in number, are placed under the seats of cars in such a manner as will protect passengers' clothes from contact with them. It is necessary to install them with some form of regulating switch, and the cost per car varies from $35 to $45 installed.

"To keep the temperature of the car, say, at 50 degrees F. in moderately cold weather, will require an expenditure of 2.66 horse-power, and in severe weather an expenditure of from 5.33 horse-power to 6.66 horse-power.

"Estimating power to cost .9 of one cent, per kilowatt hour, we can arrive at the cost of heating a car per day of 18 hours as follows:

"In moderately cold weather, using 2.66 horse-power, or 36 kilowatt hours, cost will be 32.4 cents; using 5.33 horse-power, or 72 kilowatt hours, cost will be 64.8 cents; using 6.66 horse-power, or 90 kilowatt hours, cost will be 81 cents. To this cost must be added the depreciation and repairs, and this we can take at 20 cents. This will add to the above cost of operating 5.1 cents per day."

NEW PUBLICATIONS.

A volume of one hundred pages has been published by Mr. F. P. Spalding, assistant professor of civil engineering Cornell University, Ithaca, N. Y., giving notes on the testing and use of hydraulic cement. The notes are designed for use as a text to a short course of instruction, as well as to serve the purpose of a hand-book in the laboratory. In the first three chapters is given a brief statement of the general properties and characteristics of hydraulic cement and its behavior under the more common contingencies of use, with a discussion of the various tests which may be applied to it, including both the ordinary tests of practice and the more elaborate ones which have been proposed, or, which are in use in the larger experimental laboratories. Mr. Spalding also gives the best and most recent practice in cement testing, pointing out the precautions necessary in making tests of quality and showing the limitations within which the results of such tests may be considered as demonstrating the value of the material. Price, $1.00.

It will be gratifying to those interested in the movement for better roads to know that hereafter official reports of the National League for Good Roads will be issued as bulletins of the United States Department of Agriculture. The first of these bulletins is a pamphlet of one hundred pages, containing the proceedings of the convention of the National League for Good Roads, held at Washington last January. It contains much of interest and value. Copies can be obtained on application to the Department of Agriculture.

A new departure in technical publication is a sixteen-page monthly, entitled *Aeronautics*, the scope of which is well indicated by the title. It is published by the *American Engineer and Railroad Journal*, and is edited by Mr. M. N. Forney. Mr. Forney's ability is well known, and he will undoubtedly develop fully the possibilities of his new field.

The annual report of Wm. Steyh, city engineer of Burlington, Ia., shows that last year $107,178 was spent for street paving. This exceeds the amount expended in any previous year. Mr. Steyh says that the expenditure should be doubled

for each of the next five years, but the limitations on the tax levy for this purpose will not permit the work to proceed more rapidly than it has heretofore.

COURT DECISIONS AFFECTING MUNICIPALITIES AND PUBLIC CONTRACTORS.

Deviating from Petition to Lay Out Highway.—Where a petition for a highway calls for a change of course at a certain point, the fact that the highway is run eight rods beyond such point before changing the course will not vitiate the proceedings, as the commissioners are not bound to follow with precision the route specified in the petition. Cecil *v.* Carman, Supr. Ct. N. Y., 23 N. Y. Supp. 386.

Boundaries of City Streets.—In ascertaining the true line of a city street, fences built by adjoining lot owners on the line of the street, according to stakes set by the surveyor soon after the original survey was made, and maintained for forty-five years, are better evidence of the location of such line than a new survey made forty years after such survey, which changes the line. City of Racine *v.* Emerson, Supr. Ct. Wis., 55 N. W. Rep. 177.

Liability of City for Defective Bridges.—A city is liable for injuries resulting from the falling of a bridge built by mill owners in a public highway, and by the side of a public bridge, where the public are allowed to use both indiscriminately, without notice as to the private character of the one in question. Detwiller *v.* City of Lansing, Supr. Ct. Mich., 55 N. W. Rep. 361.

Adoption by Council of Expenditures by Committee.—Where city councils adopt and ratify the acts of a committee thereof in making necessary expenditures, which, however, the committee had not authority to make, the city will be bound thereby. The requirement that proposals to furnish a city with materials needed shall be advertised for need not be complied with where the thing needed is part of a patented article, which can be bought only at one place. The provision of an ordinance that the fire committee of a city council shall have power to contract for necessary repairs, not to exceed a certain amount, does not prevent the council from adopting the act of the committee in making a larger expenditure. Silsby Mfg. Co. *v.* City of Allentown, Supr. Ct. Pa., 26 Atl. Rep. 646.

Negligence of Sub-Contractors.—Where a person obtains from a city, by ordinance, license to lay pipes along its streets, he will be liable for injuries resulting from the negligent manner in which such work is done, even though the work is not done by himself, but by an independent contractor employed by him for that purpose. Colgrove *v.* Smith, Supr. Ct. of Cal., 33 Pac. Rep. 115.

Validity of Assessment for Street Improvements. — Under a charter conferring on a city power to pave its streets, and to require owners of adjacent lots to pave one-half in width of the street contiguous to their respective lots, the owners of lots on each side of the street are required to pay for one-half of the paving, whether the paving covers a part only or the full width of the street, and whether the paving is in the center of the street or on one side only; and, where the paving is on one side only, the adjacent owner on that side is only liable for one-half the expense. Under a city charter authorizing it to require the abutting lot-owners to

pave a street, a railroad company having a right to lay its track on a lot, but to which it did not have title, is not liable for paving the street. City of Muscatine *v.* Chicago, R. I. & P. R. R. Co., Sup. Ct. of Iowa, 55 N. W. Rep. 100.

Remedy at Law for Trespass.—Where a contractor has made a valid contract with a city to pave and curb a street, and is liable for penalties for its non-performance, he is entitled to an injunction against trespassers who prevent him from doing the work, as he has no adequate remedy at law, and an injunction will avoid a multiplicity of suits. Palmer *v.* Israel, Supr. Ct. of Montana, 33 Pac. Rep. 134.

Payment of Damages by City, and Recovery from Property Owner.—Where a cellarway, trap-door or scuttle or the like is put in a public sidewalk for the convenience of the abutting property, as between the owner and the city, the duty of maintaining it in a safe condition devolves upon the former, and he can not release himself of his duty by merely abandoning the use of the structure. He can only do so by removing it and restoring the sidewalk to its original condition. If, through the negligence of the property owner, the structure becomes unsafe and injury results, for which the city is liable because of neglect of its duty to keep its streets in a safe condition for travel, it may, upon payment of the damages to the person injured, recover from the owner by whose fault, "as between him and it," the injury was occasioned. City of Wabash *v.* Southworth, Supr. Ct. of Minn., 55 N. W. Rep. 818.

Action for Injuries Caused by Defective Street.—Where the statute provides that whenever any person is injured by reason of any defect in any street, or for any other cause for which the city would be liable, and such injury shall be caused by the negligence of any person or corporation or towns, such person or corporation or towns shall be primarily liable for all damage arising from such injury, but such city may be sued in the same action with the one so primarily liable. Such statute is not limited in its application to cases in which the person guilty of such wrong, default or negligence sustains no contract relation to such city, but applies as well where such person was grading a street under a contract with the city. Kollock *v.* City of Madison, Supr. Ct. of Wis., 54 N. W. Rep. 725.

Liability of City for Defective Sidewalk.—Where an action against a city for injuries sustained by a defect in the sidewalk, the evidence showing that the flagging in the sidewalk had a hole in it from five to six inches in diameter, in which one caught her foot and fell, it appearing that the hole was in the flagging when it was laid, five or six years before the accident, and it had originally been filled with dirt, but it had been partially swept out, so that at the time of the accident it was about an inch deep at the edges, and deeper in the middle, the surface being saucer-shaped, a jury was warranted in finding that the hole was a defect for which the city was responsible, under the statute providing that, if a person suffers injury through a defect in a highway which might have been remedied with reasonable care, he may recover. Marvin *v.* City of New Bedford, Supr. Ct. of Mass., 33 N. E. Rep. 605.

Rights of Lowest Bidder.—Where, by statute, public officers are required to advertise for bids for the

performance of certain public work, and to give the contract to the lowest bidder, the person whose bid is lowest is entitled to the contract, and can enforce his rights by mandamus, or by action against the officers for specific performance, or perhaps for damages. This is upon the principle that a tender and acceptance constitute an agreement, and it was held that where bids were called for for the performance of certain work according to certain specifications, the work to be given to the lowest bidder, that the lowest bidder for the work, even though his bid was informal, amounted to a tender on his part and an acceptance on the part of the owner which made a complete and binding contract, and its provisions were enforced against him.

And though nothing is said in the call for bids as to whether the work shall be given to the lowest bidder, yet, if such is the custom and common understanding, the lowest bidder has a right to treat his bid as accepted, unless it is expressly rejected. But if by the terms of the call for bids a written contract is to be entered into and signed by the parties, after acceptance, the contract is not complete until this is done, and it seems that either party may withdraw before this is done. In fact, if anything is left open to be done before the agreement is complete, either party may recede. In order to make the bid and acceptance a complete contract, nothing must be left to be done by the parties. When a call for a bid for work refers to a certain plan and specification, the plans and specifications are treated as incorporated into, and forming a part of the contract as well as all other matters referred to in the call. And where compensation is to be made out of a particular fund, no claim can be made except against that fund.

When, however, the law does not require the work to be given to the lowest bidder, and the call for bids does not state that the work will be so given, or when any discretion is vested in the contracting board, the lowest bidder can not enforce his claim. The same is true in the case of an individual advertising for bids for the doing of certain work, unless he expressly states in the call that the work shall be given to the lowest bidder, or there is some custom regulating the matter, he is at liberty to accept any bid which he deems most advantageous, whether it is the lowest or not. Abstracted from Wood on "Master and Servant."

PERSONALS.

Prof. E. J. De Smedt, of New York, is supervising the laying of asphalt pavements in Utica, N. Y., and Detroit, Mich.

Messrs. McClintock and Woodfall have taken up a new suite of offices at 15 Court Square, Boston, Mass., adjoining the rooms of the Massachusetts Highway Commission, of which Mr. McClintock is a member.

Mr. Charles E. Brown, of New York, has been appointed city engineer of the city of Indianapolis. He has taught civil engineering at Union College, Schenectady, N.Y., and at Rose Polytechnic, Terre Haute. Mr. Brown aided in the lake survey at Detroit, and in the topographical survey in New York, and of late has been employed by the state health board of New York to investigate the different waterworks systems of the state.

MACHINERY AND TRADE.

SOME RECENT PATENTS.

A Ditching Machine, 504,728. Ottis Hughes, Vernon, and Jeremiah S. Hull, Lock Spring, Ind. This invention comprises a vertically adjustable frame, a gear wheel mounted in the frame and having a suitable crank formed thereon, a shovel bar pivoted on the crank, a radius bar pivoted on the shovel beam intermediate between the ends thereof and to the main frame, a vertically moving digging bit, an oscillating lever connecting the shovel and digging bit and means for rotating the gear wheel.

A Pipe Joint and Coupler, 504,739. James A. Murry, Minneapolis, Minn. This invention comprises a section of pipe having at its end an annular groove formed in its face and a circumferential flange lying outside of the groove and in the same plane with the face end of the pipe and formed with open slots, the other section of pipe having a rib projecting from its face to enter the groove in the opposite section and formed with a circumferential flange lying outside of said rib and having open slots registering with the open slots in the flange of the other pipe section, the flange to one of the pipe sections having a groove formed in its rear face, button-bolts hinged to one section back of its flange and lying in the slot of that flange and also in the slot of the opposite flange whereby the walls of the slot in both sections form a brace for the bolts and take the strain from their hinges, a washer applied to the ends of the bolts and lying in the groove of one flange, and nuts for clamping the parts together.

Manufacture of Artificial Stone, 505,082. Franz F. Von Ainbach, Knittelfeld, Austria-Hungary. This invention consists of powdered and burnt magnesite and an aqueous solution of tungstate of soda.

An Apparatus for Treating Sewage, 505,166. Oluf E. Meyer, Milwaukee, Wis. This invention comprises a conduit through which the sewage flows, a tank or receptacle for holding chemicals to be introduced into the sewage, a connection with the tank or receptacle opening into the conduit and provided with a valve, and a plate exposed to the force of the current in the conduit and connected with the valve.

A Sewer Trap, 505,302. Peter Standar, Belleville, Ill. This invention comprises a sewer having an opening in its side and a recess in its inner face below and communicating with the opening, a pipe fitting in the opening and having on its end within the sewer an inverted bell, the latter having a portion thereof in the recess and supported on the lower wall thereof.

A Street Sweeper, 505,455. James R. Gallagher, Buena Vista, N. J. This invention comprises an adjustable revolving brush driven from an axle carrying the main weight of the machine, stationary brushes, inclosing the space in which the revolving brush is operating on three sides, while the front side is closed by an end-transverse brace of the conveyer frame, and with the conveyer, mounted in an S-shaped oscillating frame, one end of which is pivotally connected with the body of the machine, while the other end is supported by rollers.

An Excavating Machine, 505,460,

William M. Gross, Spokane, Wash. This invention comprises a supporting frame, a bucket wheel having a construction adapted to receive, elevate and discharge the material therein, an unyielding excavator support in the frame, an excavator held rigidly therein, and means actuated by a single lever for adjusting the excavator horizontally in a straight line.

A Closed Conduit for Electric Railways, 505,605. Geo. W. McNear, Oakland, Cal. This invention comprises conduit arms, yokes, brackets resting on one side of the arms, an insulating strip or bar carried by the brackets and having a hollowed out or concave lower side, and a flexible insulating diaphragm secured to the strip or bar and crossing its hollow or concave side whereby an envelope or sack is formed for the electrical conductor and contact strips.

A Garbage Furnace, 505,656. Bernard C. Heavey, Chicago, Ill. This invention comprises combustion chambers, extending one above the other, a grate between the chambers, a feed chute extending to the upper chamber, a door for the chute, burners and stoke openings at both chambers, a retort above the upper chamber and communicating therewith through a central opening, outlet flues extending from opposite ends of the retort and means for controlling the draft through the furnace.

Non-Shearing Rod for Strengthening Concrete Work, 505,664. Thos. A. Lee, Kansas City, Mo. This invention consists of two or more bars or stiff strands laid spirally together to form spiral channels for the adhesion of cement, concrete or other surrounding material.

An Asphalt Pavement, 505,699. Charles H. Bull, New York, N. Y. This invention comprises a concrete base having a bonding of separate and independent filaments extending above its upper surface and an asphaltum sheeting having a bonding of separate and independent filaments and also bonded to the concrete by the filaments projecting upwardly therefrom, whereby the sheeting will be prevented from sliding on the base and the component parts of the sheeting will be prevented from separating by heat or travel.

Production of Artificial Stone, 505,747. Granville M. Breinig, New Milford, Conn. This invention consists of crushed quartz, ground calcined quartz, and a hydraulic cement.

A Street Sweeper, 505,796. John C. Slawson, Indianapolis, Ind. This invention comprises a brush casing supported from the rear axle thereof, shafts having bearings in the walls of such casing, sprocket wheels mounted thereon, chains connecting such wheels and carrying detachable brushes, flexible aprons of any suitable material between such brushes and forming pockets for elevating the material swept up, an apron composed of sections forming the front wall of the casing, and connected to eccentrics or similar mechanism, whereby the apron is oscillated or moved toward and from the brushes, and in front of the same.

Combined Conduit and Curb, 506,018. Nels Sampson, Norwood Park, Ill. This invention comprises a drain covered and enclosed in a bed of gravel, forming a foundation for the curb and conduit proper, a conduit proper formed of artificial stone and tiling embedded in the artificial

stone forming the curb and conduit proper.

V. H. Lockwood, Patent Att'y.
60 East Market St., Indianapolis.

VITRIFIED BRICK IN KANSAS.

The premium offered for the finest vitrified brick at the World's Fair was awarded the Capital City Vitrified Brick and Paving Company of Topeka, Kan. Mr. J. W. Boltz, who successfully operates the plant, is one of the men, who, experimenting in Illinois about ten years ago, found that by exposing a certain kind of clay to the heat for a longer time than common brick was kept in the kiln, caused vitrification to take place. The clay found in Kansas is said to be the best in the world for making vitrified brick, because of the large amount of soap-stone found in it. Vitrified brick is becoming a favored material in Kansas towns, and is being adopted generally for its hardness and durability, and it is more especially favored for paving sidewalks, being considered, out there, only a question of time when it will be used altogether for that purpose.

NEW BRICK KILNS.

Among recent sales of kilns made by E. M. Pike, Chenoa, Ill., are the following: Jas. McKeen, La Junta, Cal.; Clinton Pottery Co., Clinton, Mo.; C. E, Burlingame, Byron, Mich.; J. L. Purple & Bro., Columbia, Pa.; South Park Tile & Brick Co., South Park, O.; A. K. Francis, Pine Grove, Pa.; Krumpe & Love, Saxonburg, Pa.; Hercules Brick Co., Chicago, Ill.

WILL ESTABLISH A PAVING BRICK PLANT.

After a series of experiments under the supervision of Superintendent Cunnington, the Pennsylvania Sewer Pipe Company, located at Huntingdon, Pa., finds that in all probability vitrified brick can be made from the same clay used in their manufacture of sewer pipe. Samples of the brick tested by government chemists have proven very satisfactory. It is probable that the company will enlarge the works and establish an additional industry to their sewer pipe manufactory.

A NEW PAVING BRICK COMPANY.

A new paving brick company, with a capital stock of $50,000, has been organized at Reynoldsville, Pa., and will be known as the Ridgway Press Brick Company. Mr. W. S. Ravenscroft, who has devoted much time and study to clays and brick-making, organized the new company, in which are enlisted some of the wealthiest business men in Reynoldsville.

A NEW FORM OF PAVING BRICK.

A lock-joint brick for building purposes, invented and patented by George E. Briggs, of Pittsburgh, Pa., seems to possess many points of merit. It varies from the uniform common brick. It is claimed that a greater bond is secured with the lock-joint brick than with the common brick. It is described by Mr. Briggs as consisting of four approximately equal rectangles, three of which are arranged side by side and attached edge to edge; the fourth is attached to the second in T shape; it will interlock with another brick of similar shape, or with a common brick in a variety of ways. It is claimed that there is a saving of 33⅓ per cent. in material and labor, and a space of four inches is gained on a wall. Each brick is equal to one-half of a common brick, and may be increased or diminished to any size, which adapts them to various standards.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

The streets of Oregan City, Ore., are being paved with vitrified brick.

Cannon street, Poughkeepsie, N. Y., is being paved with vitrified brick.

Jefferson street, Memphis, Tenn., presents a beautiful appearance since the completion of the new brick pavement.

The paving of K street, Sacramento, Cal., with granite blocks, has proven highly satisfactory. The entire contract cost $29,000.

Washington street, Green Bay, Wis., presents a very handsome appearance since the completion of its cedar block pavements.

The macadamizing of the turnpike between Hiram and Garrettsville, O., opens five miles of the best road in the northern part of the state.

The vitrified brick pavements, recently completed in the business streets of Winona, Minn., give general satisfaction as a substantial improvment.

About three miles of pavements have been laid in Erie, Pa., this year, of which more than one-half is brick, the remainder being asphalt and stone. All have been put down under ten years' guaranty.

Orange avenue, on Coronado Beach, Cal., will become a popular throughfare for driving since the completion of the paving, which renders it as hard and compact as stone. Twelve hundred carloads of gravel have been used in the work.

The Electric Traction Company will spend about $4,000,000 in repaving Second, Third, Fifth, Sixth, Tenth, Eleventh, Lombard, South and other streets in Philadelphia in which its lines are laid. Granite blocks will be used for the work.

The mountain boulevard being constructed at Chattanooga, Tenn., is progressing rapidly, and when completed will be one of the finest roadways in the country. It will be three and one-eighteenth miles in length, forty feet wide and is perfectly level.

When the work now under contract in New York City is completed, more miles of streets will have been newly paved this year than in any previous year in that city. Contracts to the amount of $1,500,000 were awarded for paving during the spring and summer. More asphalt pavement has been laid this year in the city than ever before.

The board of public works, Kansas City, Mo., has recommended the paving of the following streets: Mulberry, Ninth to Union avenue; Grand, Ninth to Thirteenth; Grand, Eighth to Ninth; West Ninth, Mulberry to State line; Broadway, Sixth to Tenth; Grand, Fifth to Independence; Walnut, Third to Fourth; Walnut, Fourth to Fifth; Walnut, Fifth to Ninth; Broadway, Eleventh to Twelfth.

The contract awarded last spring in Washington, D. C., to the Bermudez Asphalt Company is completed, and the results of the work seem highly satisfactory to the commissioners of the district. The fine character of work and the binding and tenacious qualities of this asphalt have surprised the officials a d the people of Washington. The pavement laid in Detroit last season by the same company, has proven itself of fine character and substantiates all claims made by the company for the superior quality of their asphalt.

CONTEMPLATED WORK.

Camp street, Newark, N. J., will be paved with sheet asphaltum.

Reading, Pa., contemplates the expenditure of $400,000 for paving purposes.

The council at Wausau, Wis., is contemplating the paving of Third street.

Market street, in Paxton, Ill., will be paved with brick on sand and gravel foundation.

The council at Goshen, Ind., is contemplating the purchase of a road roller for the streets.

Assessments have been made in Detroit, Mich., for grading and paving Sixteenth and Mullett streets.

Twenty-second avenue, from the Union Station to Second avenue, Meridian, Miss., is to be macadamized.

The property owners along Main street, Stevens Point, Wis., are petitioning for a 24-foot cedar block pavement.

The board of supervisors, San Francisco, Cal., has passed resolutions favoring extensive street improvements.

Plymouth, Mass., contemplates widening Middle street to a uniform width of 35 feet. The work will cost about $12,000.

An ordinance has been passed by the council at Baltimore, Md., favoring the repaving of McCulloh street, with asphalt blocks.

An ordinance has been passed in Toledo, Ohio, favoring the paving of Tecumseh street, from Division street to the City Park avenue.

Silver street, in New Albany, is to be improved. It will be 92 feet wide and 6,000 feet long and will be one of the handsomest thoroughfares in that city.

The improvement of Church street is being agitated in Norfolk, Va. If successful in the efforts being made, this street will be the greatest thoroughfare in Norfolk.

L. L. Harper, city engineer at Litchfield, Ill., writes that the city council passed an ordinance favoring paving with brick, Monroe street from Edwards to Hayward street.

The board of public improvements, St. Louis, Mo., will hold a special meeting, November 7, for the purpose of considering the improvement of a number of streets in that city.

Plans for grading and curbing in district No. 2, at an estimated cost of $158,720, have been accepted by the board of public works in Denver, Col., which has ordered published notice of proposed action.

A delegation recently called on Mayor Latrobe, Baltimore, Md., asking that the widened portion of Fayette street be paved. The city council will be asked to pass an ordinance favoring the petition.

Chestnut street, Lynn, Mass., will be widened under the highway act. The improvement necessitates the taking of 1,219 square feet of land from the westerly side of the street, and 682 square feet from the easterly side.

The roads and finance committees at Montreal, Canada, have recommended that Mackay street be paved with rock ledge, at a cost of $16,467.75; Lagauchetiere street, with macadam, at a cost of $3,420; Atwood avenue macadamized, at a cost of $10,000.

The street opening commissioner at Minneapolis, Minn., has ordered the opening of Bjornson avenue, from its present terminus to Locust street; to widen Thirty-first avenue to its original width of 90 feet. The commissioner is also considering the proposed widening of Main street.

The board of public works, Kansas City, Mo., recently approved ordinances for paving the following streets: Twenty-fifth street, Vine street, Thirteenth street, Union avenue, Brooklyn avenue and Washington street. The city engineer also compiled a list of streets in need of paving, upon which ordinances will be passed as soon as all of the board can meet together.

CONTRACTS TO BE LET.

Bids are invited until November 3, in St. Louis, Mo., for grading, curbing and constructing Telford pavements in several streets in that city.

Sealed proposals will be received, until November 20, by Sylvester Lamb, Toledo, O., for paving East Broadway and Tecumseh streets with either cedar block, vitrified brick or Medina stone blocks.

Bids are invited, until November 6, at East Orange, N. J., for laying artificial stone sidewalks, as follows: West side of Burnet street, north side of William street, north side of Fourth avenue, south side of William street, north and south side of Grove street, north side of Carnegie avenue.

CONTRACTS AWARDED.

John Martin, of Oshkosh, was awarded the paving contract at Menasha, Wis., at his bid of $4,263.

John Streicher secured the contract for paving Jefferson street with cedar block, at Toledo, Ohio.

Trombley & Eldert were awarded the contract for macadamizing the roads at Hempstead, N. Y.

The contract for paving Main street, Fostoria, Ohio, was awarded the Standard Construction Company.

C. Beck & Co. secured the contract for paving Greenfield avenue, from Clinton street to the bridge, Milwaukee, Wis.

The Standard Paving Company secured the contract for replacing the wooden pavement in Cuming street, Omaha, Neb., with asphalt.

The city council at Springfield, Ill., awarded to John F. Bretz the contracts for paving South Seventh and South Ninth streets, at $1.51 per yard.

Contracts for paving in Newark, N. J., were awarded as follows: Court, West McKinney and High streets, John F. Shanley; River street, Thomas J. Regan.

The contract for the Nineteenth street paving, Denver, Col., was awarded the Colorado Paving Company for $45,587.93. The Blake Asphalt Company received the contract for Larimer street, for $42,871.

R. A. Montgomery, of Lambertville, secured the contract for macadamizing the Scotch road from Trenton to Ewing, N. J., a distance of five miles. The cost will be $50,000.

The commissioners of public works, Peoria, Ill., awarded the contract for paving Prairie street to Nicholas Becker. The pavement will be of brick, and will cost $1.49 per square yard.

The Warren-Scharf Paving Company was awarded the contracts for paving in Syracuse, N. Y., as follows: South Geddes street, 18,200 square yards asphalt pavement and 8,250 square yards sandstone block pavement, $84,755.

L. L. Harper, Litchfield, Ill., writes that the contract for paving Monroe street was awarded Edward Sexton, as follows: Two courses of vitrified brick, on gravel foundation, $1.38 per square yard; curbing, 2½ in. by 12 in., 9 cents per lineal foot.

A. H. Davidson, city engineer at Augusta, Ga., writes that contracts were awarded Venable Bros., of Atlanta, as follows: For laying 4,351 square yards of stone block pavement at 58 cents per square yard, the city furnishing the block, and 1,396 lineal feet of 5x18 granite curb at 36 cents per foot; 7,988 square yards of stone block pavement at $1.78 per square yard and 5,314 lineal feet of 5x18 granite curb at 36 cents per lineal foot.

Harvey Linton, city engineer at Altoona, Pa., reports the letting of contracts in that city as follows: Paving Twelfth street, 433 square yards vitrified brick on 6-inch concrete foundation, at $2.50 per square yard, Pennock & Vipond; paving Green alley between Tenth and Eleventh streets, 560 square yards, vitrified brick on concrete foundation, at $2.50 per square yard, Pennock & Vipond; grading Eighth avenue, 900 cubic yards earth at 35 cents per cubic yard, and loose rock at 60 cents per cubic yard, Henry Elway.

The contract for paving St. Louis avenue, Kansas City, was divided and awarded two firms. Robert J. Boyd, of St. Joseph, secured the contract for paving it from Santa Fe street to the west line of Turner and Co.'s addition, with vitrified brick on sand and concrete foundation at $1.74½ per square yard. James O'Donnell, of Kansas City, was awarded the contract for paving, with the same materials, from Turner and Co.'s addition to the State line, at $1.70 per square yard. The total cost of the two contracts will be about $19,000.

The board of public works in Indianapolis has awarded paving contracts as follows: Asphalting North street, from Meridian to Pennsylvania, Western Paving and Supply Company, $7.60 per foot; paving the first alley east of Pennsyvania street, from Chesapeake to Georgia, Browder & Shover, Wabash brick, No. 2, $3.06 per lineal foot; paving the first alley west of Meridian street, from Washington to Georgia, Browder & Shover, Wabash brick, No. 2, $1.80 per lineal foot; paving the first alley west of Tennessee street, from Washington to Maryland, Browder & Shover, Wabash brick, No. 2, $1.79 per lineal foot; paving the first alley north of New York street, from Pennsylvania to Delaware street, Browder & Shover, Wabash brick, No. 2, $1.53 per lineal foot.

Contracts for ten squares of street paving and amounting to $15,000 have been awarded in Bellaire, O., by the city council.

The Barber Asphalt Company has the contract for repaving Main street in Kansas City, Mo. The street is to be relaid with asphalt on the old concrete with an addition of two inches of new concrete.

H. H. Wagoner, Huntington, Ind., writes that the city council awarded contracts for paving with Hallwood block, at $1.37 per square yard, 2,433 feet of Williams street, and 982 feet of Washington street.

A. G. Pugh & Co. were awarded the contract for paving Town street, Columbus, O., from High street to the east end of the bridge over the Scioto river. The paving will be done with first-class Medina stone block. The contract will amount to $18,000.

Contracts for street paving in Buffalo, N. Y., amounting to more than $200,000, have been awarded as follows: Paving French street, from Fillmore avenue to Moselle street with Germon rock, at an outlay of $40,891; Goodyear avenue, from Walden to Genesee street with Barber's asphalt, $2,824; Chandler street, from Military Road to the New York Central tracks, Barber's asphalt, $24,528; Stortz avenue, from East Utica street to Glenwood avenue, Barber's asphalt, $3,981; Mills street, from Sycamore to Genesee, German rock, $18,876; Tennessee street, from South to Mackinaw street, Barber's asphalt, $16,311; Alabama street, from Elk to Fulton, Barber's asphalt, $4,124; Alabama street, from Fulton to Perry, Barber's asphalt, $4,112; Scott, from Michigan to Chicago, P. B. McNaughton, $10,316; Bird avenue, from Soldier's Place to Delaware, Barber's asphalt, $14,185; Moselle street, from Walden avenue to Genesee street, German rock, $18,799.

SEWERAGE.

Six miles of sewers have been laid in Davenport, Ia., during the past year.

A sewer is being constructed in the village of Highland Park, Mich., at a cost of $60,000.

During the past four years Columbus, O., has expended $1,000,000 in the construction of sewers.

Denver, Colo., has over 124 miles of sewers, which cost the city $1,590,000. This does not include the work now under course of construction.

At Topeka, Kan., Christian States has completed 2,488 feet of fifteen-inch double strength vitrified pipe sewer at an average depth of eight feet, with nine man-holes and one outlet for $1,445.

Bids for the construction of the Willow Run sewer at Covington, Ky., ranged from $90,000 to $150,000. The contract has not yet been awarded.

The Negley Run sewer, which is being constructed at Pittsburgh, Pa., will be 12,000 feet long, nine feet in diameter at its mouth and will cost more than $150,000.

A sewer district has been formed in the First ward at Topeka, Kan., which will have twelve miles of pipe sewer and two miles and a half of brick sewer, and will cost $130,000.

A plan has been submitted to the board of supervisors at San Francisco, for the construction of a sewer outlet through the Presidio reservation, which would also drain the Presidio Heights. The sewer is estimated at a length of 2,400 feet, with a total fall of 60 feet, and 1,500 feet of tunneling. The cost would be about $20,000.

The large outlet sewer being constructed at Schenectady, N. Y., is rapidly nearing completion. This sewer is 7,000 feet long and empties into the river below the city, and it will be remembered that the object in building this sewer is to take the sewage from the upper part of the city in order to relieve the sewers in the lower part of it.

Section eight of the outfall sewer at Los Angeles, Cal., is a circular, brick sewer, 40 inches in diameter and 4,778 feet in length. The grade is one foot in 800 feet. The section is known as open cut work, or, has been put in without tunneling. The lower half is plastered over to render it smooth, so as to offer the least resistance to the flow of sewage.

CONTEMPLATED WORK.

A good system of sewerage is being agitated at Granville, O.

A system of sewers is being contemplated at Morgantown, W. Va.

A storm sewer is to be constructed at Reading, Pa., which will cost $200,000.

Legislation has been made in Jersey City, N. J., for sewers in Congress and Leonard streets.

The council of Syracuse, N. Y., has declared its intention of building new sewers in North Salina street.

Plans and specifications have been submitted for the rebuilding of 1,000 feet of the sewer in Third street, at Great Falls, Mont.

The common council of Toledo, Ohio, has ordained that cylindrical brick sewers be constructed in Delaware avenue and Third street.

The council of Cleveland, O., has resolved to construct sewers in Beechwood, Woolsey, Bayne, Maud and Harvard streets, and Miles avenue.

A large trunk sewer with lateral connections, is to be built on Second avenue and Tecumseh street, Pittsburgh, Pa., during the winter.

The city council of Davenport, Ia., has adopted resolutions favoring the construction of lateral sewers in Sixteenth, Harrison, Ripley and Brady streets.

A sewer, 18,000 feet long and thirty inches in diameter, is proposed at Skaneateles, N. Y. The sewer will be built by the authorities of Syracuse and will cost $15,000.

An election will be held November 14 and 15 in Meridian, Miss., to determine whether or not bonds shall be issued to the amount of $100,000 for the construction of sewers.

The president and members of the board of public works, of Camden, N. J., have been petitioned by property owners to order sewers built in Atlantic avenue and Third street.

The board of trustees at Brightwood, Ind., has ordered the construction of a sewer, along the Glen Drive, intended to receive sewage from collateral sewers which may be constructed in the future.

Ordinances have been passed in Newark, N. J., for the construction of sewers, as follows: James street, from Boyden to Nesbit street; Camp street, from Mulberry to Orchard; South Thirteenth street, from Gould street to Ninth avenue.

A special election will be held November 7, at Brushton, Pa., for the purpose of voting on the issuance of the necessary bonds to build a sewerage system for that borough. The Brushton councils have decided to spend $56,000 in constructing the system.

The council at Reading, Pa., passed a bill in favor of the construction of a house sewerage system in the First district. The work is to be done at the expense of the property owners in the district, while the city has appropriated $100,000 for the construction of a sewage disposal plant.

CONTRACTS TO BE LET.

Bids are invited until November 2, for a sewer in Lindsey street, Newport, Ky.

Bids are invited until November 7, for the construction of a sewer in Terrace street, Brooklyn Village, O.

Sealed proposals will be received until November 3, for the construction of a sewer in Chippewa street, St. Louis, Mo.

Sylvester Lamb, city clerk at Toledo, O., invites bids, until November 6, for constructing cylindrical brick sewers in Delaware avenue, Third street, alley between Bartlett street and Oakwood avenue and an alley between Platt street and Oswald street.

Bids are invited, until November 2, at Newport, Ky., for the construction of sewers in Lindsey, Sixth and Third streets.

At Austin, Ill., bids are invited, until November 4, for the construction of pipe sewers in Kenilworth avenue, Harrison street, Robinson avenue and Cuyler avenue.

H. J. Jones, commissioner of public works at Chicago, Ill., asks bids, until November 6, for laying brick and pipe sewers in sundry streets and avenues in sections A, B and C.

Sealed proposals will be received at Jersey City, N. J., until November 6, for constructing a twenty-four inch brick oval sewer in Reservoir avenue and an eighteen inch brick oval sewer in Congress street.

CONTRACTS AWARDED.

The contract for a sewer system at Leominster, Mass., has been awarded Staples Brothers, of Lowell.

M. J. Huse secured the contracts for sewer and water connections in Erskine street, Omaha, Neb.

The contract for building the New Britain avenue sewer, Hartford, Conn., was awarded Michael O'Neil for $3,650.90.

The contract for the construction of a lateral sewer on Tremont street, Davenport, Ia., was awarded Sparbel & Co.

The contract for constructing the one block extension of the Sunnyside sewer, Portland, Ore., was awarded B. S. Riley.

H. Ward, Binghamton, N. Y., writes that the contract for building the Virgil street sewer was awarded E. A. Matthews for $930.

The contract for building the Montgomery avenue sewer at Litchfield, Ill., was awarded Wilson & Rives at 75 cents per lineal foot.

Rider & Fitzgerald, of Dunkirk, N. Y., were awarded the contract for the construction of sewers in Jamestown. Their bid was $55,666.56.

Lewis Kingman, city engineer at Topeka, Kan., writes that C. J. Rosen was awarded the contract for constructing all of the sewers in district 16. The total cost of the work will be $4,883.73.

T. O. Buren secured the contracts for two brick sewers at Augusta, Ga.: One 1,200 feet long and 4.16x5.45 feet in diameter, and the other 1,500 feet long and 2.66 x4 to 3.42x4.42 feet in diameter.

B. R. Morton, Newport, Ky., writes that contracts for sewers in that city have been awarded, as follows: Fourth, Fifth, Sixth and Seventh streets, Wm. White; Eighth and Tenth streets, Van Zandt & Mead.

J. Tudor Graves, city engineer at Fargo, N. D., writes that the contract for lateral sewers has been awarded Allen & Kennedy, of that city. The contract comprises about three miles of pipe sewer, nine-inch to twenty-inch.

Cass county, in North Dakota, has under construction three drains, aggregating about twelve miles in all. The largest is twenty inches wide at the bottom and four miles long. George Foley, of Foley Bros. & Guthrie, has the contract.

F. W. Allison writes that the city council of Salem, Ohio, awarded to W. J. Gaune, of Cleveland, the contract for constructing a storm water sewer, two ring-brick, 2,400 feet long and three and one-half by four and one-half feet wide, at a cost of $8,984.

James Blair, Adrian, Mich., writes that Bowen & Tynan, of that city, secured contracts for sewer as follows: 9,737 feet of eight-inch pipe sewer at 50 cents per lineal foot, and fifteen man-holes, $12 each; 290 lineal feet of thirty-inch double ring brick sewer, $1.80 per lineal foot.

Adna Dobson, city engineer at Lincoln, Neb., reports that F. W. Krone secured the contracts for two sewers to be constructed; one in the alley between O and P streets, from Twenty-third to Thirtieth street, $1,382.80; Vine street, from Thirteenth to Twentieth street, $1,382.60.

The board of public works, Milwaukee, Wis., awarded contracts for sewers as follows: Twenty-second street, 341 feet, James O'Donnell, $1.23 per lineal foot; Eleventh street, 733 feet, James O'Donnell, $1.27 per lineal foot; Twenty-eighth street, 1,766 feet, G. E. Zimmermann, $1.23 per lineal foot; Pine avenue, 540 feet, R. J. Wilson, $1.52 per lineal foot; Fourteenth avenue, 540 feet, R. J. Wilson, $4.50 per lineal foot.

Muir Bros. & Nicholson secured the contract for constructing 8,000 feet of brick sewer in Indianapolis. Lateral sewers will be extended from the brick sewer to the curb lines on each side of the street, in every 25 feet, making 66 feet of lateral sewer to every 25 feet of brick sewer. This is done in order to prevent the street from being torn up in the future when making house connections. The work will cost $40,000.

Contracts for the construction of sewers in Buffalo, N. Y., were awarded as follows: Milton street, John Mumm, $1,240; Liddell street, W. S. Barnes, $850; Ludington street, A. D. McConnell, $1,880; Genesee street, August Gisel, $1,190; Jefferson street, A. D. McConnell, $6,400; Glendale Place, W. A. Green, $1,007; Nevada avenue, A. D. McConnell, $1,691; Esser street, E. J. Green, $10,827; Pearl street, Henry Harter, $81, and Newell avenue, Patrick Battel, $1,219.

T. W. Reilly and Fritchie, of Lancaster, Pa., secured the contract in Germantown, for constructing a big sewer, 1,200 feet long, seven feet in diameter and to be laid 36 feet under ground. The estimated cost is $37,200.

Sewer contracts have been awarded in Altoona, Pa., as follows: Margaret street, 150 feet, eight-inch vitrified salt-glazed pipe sewer, at 80 cents per foot, and 750 feet ten-inch sewer, at $1.10 per foot, Henry Elway; Sixth avenue, 1,290 feet ten-inch vitrified sewer pipe, in both sides of the street, at 67 cents per foot, Isaac Bender; Lexington alley, 500 feet eight-inch pipe and 480 feet sixteen-inch sewer pipe, at 59 cents per lineal foot, Isaac Bender.

A. B. Celiax, Hazleton, Pa., writes that the city council has awarded contracts for two sewers, as follows: One thousand feet of fifteen-inch terra cotta pipe sewer, John Bringenberg, at $1.50 per lineal foot; stone man-holes, at $25 each, and stone inlets, with trap and catch-basin, at $65 each. The average depth of this sewer will be ten feet. A stone arch sewer, eight feet in diameter and two and one-half-foot side-walls, awarded Simon Bube, at $9.50 per lineal foot.

Sewer contracts have been awarded in Syracuse, N. Y., as follows: Orange street, eighteen-inch tile sewer, $1,385.70, Marshall street, twelve-inch tile sewer, $1,459, James Swift; Dudley street, eighteen-inch tile sewer, $410.75, Elm street, eighteen inch tile sewer, $1,973, N. Geddes street, fifteen-inch tile sewer, $2,353.50, Cortland avenue, eighteen-inch tile sewer, Furman street, fifteen-inch tile sewer, $2,028.80, L. D. Hulburt; Dell street, fifteen-inch tile sewer, $875.70, Lemon street, twelve inch tile sewer, $260.50, Hartson street, fifteen-inch tile sewer, $400, Richard Barrington; Elliott street, fifteen-inch tile sewer, $526, James Barry; Beech street, eighteen-inch tile sewer, $2,047.40, Rowland street, fifteen-inch tile sewer, $944.50, John W. Bustin; S. Geddes street, fifteen-inch tile sewer, $1,576, John Murphy; Park avenue, eighteen-inch tile sewer, Lakeview avenue, fifteen-inch tile sewer, $2,294.90, John Kelly.

WATER-WORKS.

The water-works plant at Boyd, Wis., is nearing completion.

The system of water-works being put in at Shiner, Tex., will cost $2,000.

The water-works at Ilion, N. Y., have been completed at a cost of $76,000.

The new reservoir at Bethlehem, Pa., holds twelve million gallons of water.

Hayward, Wis., has a complete system of public water-works which cost $28,000.

Brenham, Tex., recently expended $3,500 on repairs and improvements to the water-works system.

The new pumping station being constructed at Roxborough, Pa., will have two pumps of 5,000,000 gallons capacity each.

The water-works at Gordon, Neb., which have been in course of construction during the summer, were submitted to a final test, recently, and pronounced of the most modern and approved plan.

The construction of the water-works at Fairport, N. Y., is being rapidly pushed. Of the eight miles of pipe to be laid, four miles are completed. The contractors hope to finish the work early in December.

As an experiment, the water commissioners have asked of the common council of Schenectady, N. Y., an appropriation of $5,000 for the purpose of constructing and maintaining, for one month, an open well, sunk into the gravel, one mile from the city and a quarter of a mile from the Mohawk river, from which the water will filter into the well, thereby clearing and purifying it. The diameter of this well will be 20 feet and a depth such as the gravel will permit will be reached. If this experiment proves successful, the city water will probably be obtained from similarly constructed wells, which method is thought to be a great gain and improvement upon the water obtained direct from the river.

CONTEMPLATED WORK.

The water-works question is being agitated at Watsonville, Cal.

The water-works system at Lincoln, Neb., will be extended at a cost of $17,500.

Surveys are being made for a proposed water-works system at North Bend, Neb.

Harrisonburg, Va., will vote on the question of issuing bonds for a better water supply.

A system of water-works will be constructed in the village of Biwabik, Minn., this fall.

A system of water-works will be constructed in the village of Ladd, Ill., at a cost of $5,000.

Lyman L. Gerry, Dover, N. H., is making surveys and preparing plans for a water supply at Ipswich, Mass.

The council of Millville, Pa., recently passed an ordinance appropriating $64,000 for a water-works system.

W. W. Denel writes that a system of water-works is proposed at Frankfort, N. Y. Correspondence relating to this subject should be addressed to Thomas Honohan, secretary board of water commissioners.

Plans have been adopted at Newark, N. J., for a reservoir with a capacity of 165,000,000 gallons. The cost is estimated at $735,000.

Plans have been adopted for a new reservoir at South Orange, N. J. It will have a capacity of 235,000,000 gallons, and will cost $860,000.

Plans for a system of water-works have been submitted to the council at Berlin, Wis. Measurements made provide 500,000 gallons per day.

Bement, Ill., is contemplating the construction of water-works. A special committee has been appointed by the council to investigate the different plants in central Illinois.

The village of Glenville, Ohio, will be bonded for $40,000 to meet a portion of the expense of the proposed water-works plant. A plant with a capacity of from 3,000,000 to 5,000,000 gallons a day is wanted.

The reservoir for the contemplated system of water-works at Corydon, Ind., will be located with a fall of 150 feet to the limits of the town. It will be fifteen feet deep, one hundred and fifty feet long and fifty feet wide.

Water-works are contemplated at the following places: Enid, O. T.; St. Anne, Ill.; Lawrenceburg, Ky.; Coal City, Ill.; Eaton Rapids, Mich.; Danville, Ill.; Lake Ann, Mich.; Unionville, Mo.; Central Covington, Ky.; El Paso, Tex., and Oregon, Mo.

CONTRACTS AWARDED.

Leon E. Scruton, Portsmouth, Ohio, will put in a new system of water-works at Sorrento, Me.

Sykes Brothers, of Buffalo, received the contract for constructing a system of water-works at Cohocton, N. Y.

Dean & Horton secured the contract for furnishing supplies for the ensuing year to the water department of Lincoln, Neb.

The Michigan Pipe Company of Bay City was awarded the contract for constructing a system of water-works at Belding, Mich.

The contract for constructing the water-works plant at Dallas, Pa., was awarded Coon & Mooney. The work is to be completed by November 15.

The contract for the new water-works at Clearfield, Pa., was awarded Harmon P. Maline at his bid of $6,000. The pipe line will be five miles in length.

The Head and Dowst Company secured the contract for constructing the pumping station and laying the feed line of pipe into the lake at Manchester, N. H., for $8,361.50.

The contract for furnishing water-works pumps at Portsmouth, Ohio, was awarded the Laidlaw-Dunn Gordon Company of Cincinnati, at their bid of $19,300.

The board of public improvements at St. Louis, Mo., awarded to Edward P. Allis & Co. the contract for furnishing the two high-service engines at Baden Station, for $132,000.

BRIDGES.

The Franklin street bridge at Evansville is completed.

An iron bridge is being built across Yellow Bank, Tyner, Ind.

Another new bridge is to be built across the Neosho, above Emporia, Kan.

A wagon bridge is being constructed at the foot of D street, Guthrie, Okla.

A new bridge is being constructed across Russian river, at Healdsburg, Cal.

A new steel driving bridge will be erected across the Mississippi at Red Wing, Minn.

The construction of the bridge across the Scioto, at Larue, Ohio, is in rapid progress.

The new bridge across the Kansas river, at Bonner Spring, Kan., will be built for $15,400.

An iron bridge will be built at the Cedar River Park road, over Dry Run, at Waterloo, Ia.

The new $50,000 bridge at Milford, Ohio, is progressing rapidly, and will be a fine improvement when completed.

Schreiber & Co., of Cincinnati, secured the contract for the steel bridge to be erected at Main street, West Covington, Ky.

The Cedar avenue bridge over Doan brook at Cleveland, Ohio, is completed, and the Water street bridge is progressing rapidly.

A bridge is being petitioned for at Newton, Tex. If built, the bridge will be 480 feet long, and will be situated across Cypress bayou.

A free bridge will be built across the river at Little Rock, Ark. The county will pay $20,000 a year for ten years for the use of the bridge.

G. A. Berner writes that the contract for the Nichols street bridge in Pottsville, Pa., was awarded the Pottsville Iron and Steel Company for $5,830.

An iron bridge, which is being constructed across Sac river, at Pickett's ford, Mo., is the first experience Dade county has ever had in bridge building.

O. R. Rauchfuss, city engineer at Joliet, Ill., writes that the contract for repairing the Jackson street bridge has been awarded Henry Latz, at his bid of $1,435.25.

New bridges are contemplated at Youngstown, Ohio, across the Mahoning river, at the following places: South avenue, South Market street, Spring Common and Brier Hill.

Surveys have been made for a new bridge to be built between Hartford and Portland, Conn. Estimates made place the cost of the bridge at $125,000, exclusive of land damages.

The commissioners of Coshocton county, Ohio, will sell, November 9, to the lowest bidder, the contract for furnishing and driving piling for protecting Miskimer's iron bridge.

J. E. Bacon, of Sumpter Valley, Ore., was awarded the contracts for the construction of two bridges, one across the Eagle creek, $525, and the other at the crossing on Lower Powder, $642.

Contracts for bridges were awarded at Syracuse, N. Y., as follows: South avenue bridge abutments, Hayes & Reith, $4,464.69; South avenue iron girder bridge, Wrought Iron Bridge Company, $2,650.

The commissioners of highways of Bruce township, Ill., has awarded to the Massilon Bridge Company the contract for a twenty-foot steel bridge with sixteen-foot roadway, to be constructed over Otter creek.

An election will be held in November, at Kansas City, Kan., for the purpose of voting on the proposition of issuing 20-year 6 per cent. bonds to the amount of $57,500 for building a new bridge over the Kaw river.

Bids are invited until November 14, Mankato, Minn., for an iron bridge across the Maple river, six miles south of Good Thunder. Separate bids will be received for two stone abutments and for the iron superstructure.

The Massilon Bridge Company was awarded the contract for constructing an iron highway bridge across Shoal creek, two miles from Litchfield, Ill. The bridge will be a seventy-six-foot span, and will cost $1,098.

The Jaynes Bridge Company of Iowa City, Iowa, secured the contract for two iron bridges, one at Bertram and one in Monroe township. Each bridge will be 100-foot span, on iron tubes, and will cost, totally, $3,000.

The contract for a bridge at Hockingport, Ohio, was awarded the Massilon Bridge Company. The bridge will be built over the Hocking river, and will consist of one span 175 feet in length, and two spans 50 feet in length.

The Groton Bridge and Manufacturing Company, of Groton, N. Y., was awarded the contract for the two bridges in the Drury toll road, at their bid of $7,042.50.

Chas. L. Proda, city engineer at Santa Cruz, Cal., writes that the board of supervisors has awarded to R. Bowen the contract for building a 60-foot redwood straining beam bridge over King's creek, near Boulder, for $294.

The bridge committee at Springfield, Ill., awarded to the Lane Bridge Company the contract for constructing a new bridge at Coal Bank, on the Sangamon river. The bridge will be iron, with a sixteen-foot roadway, and will cost $5,614.

The contract for the new steel bridge at Smith street, Manistee, Mich., has been awarded the Milwaukee Bridge and Iron Works. The dimensions of the bridge are: 200-foot steel swing span, 200-foot steel approach, and stone foundation.

A bow spring suspension bridge, made of wire and 250 feet in length, will be built by the Van Buren Bridge Company, which will connect Chicapu with Van Buren, Mo. The estimated cost is $5,600.

M. R. Lowry writes that the Wrought Iron Bridge Company was awarded the contract for constructing an iron tubular bridge over the Red river at Union avenue, Fergus Falls, Minn. The entire bridge, substructure and superstructure, will cost $2,700.

The contract for grading 1,007 cubic yards of the south approaches to the East Wheatland bridge, Wheatland, Ill., was awarded H. A. Caguin, at 15½ cents per cubic yard, and the contract for the north side approaches was awarded Wm. Rudd, 2,169 cubic yards at 12½ cents.

Sealed proposals will be received in Fort Dodge, Iowa, until November 13, for five bridges, as follows: One twenty-foot piling bridge in Washington township; one twenty-four-foot piling bridge in DeerCreek township; one thirty-foot piling bridge in Fulton township; one twenty-foot piling bridge in Badger township, and one truss wire bridge forty feet long in Washington township.

The Toledo Bridge Company presented the lowest bid for the new iron bridge over the Miami canal on Western avenue, at Toledo, Ohio, their bid being $6,093.80. The structure will be a single span, counter-balanced swing bridge, with a roadway of 18 feet in clear width and two walks, each five feet clear. The bridge is designed to carry a 15-ton road roller, a double track street car line and a load of 100 pounds per square foot.

STREET LIGHTING.

An electric light plant will be put in at Joliet, Ill.

The Western Electric Company, of Chicago, is putting in a $20,000 electric light plant at Rochester, Minn.

Youngstown, O., will vote in November on the proposition to issue bonds for $100,000 to establish its own electric light plant.

The town board at Flatbush, L. I., has contracted with the Knickerbocker Electric Light Company for three hundred electric lights.

An electric plant, costing $10,000 will be erected at Russellville, Ky. The city council has contracted with the company for lighting the city.

PUBLIC PARKS.

The citizens of Maroa, Ill., are discussing the question of a public park.

Interest is being aroused at Manistee, Mich., in the matter of a city park. Indications point favorably to success in the movement, at present.

A new park is to be opened at Richmond, Ind., containing three hundred acres of ground. A lake, occupying sixty acres, and a grand boulevard, will be the main features of the park.

The citizens of Avondale, O., will vote this fall whether or not to issue bonds for the purchase of land for a park. The proposed park contains 138 acres of land in area, a mile in length and a quarter of a mile in breadth.

The parks, in Columbus, O., are so situated that each part of the city includes one, making it possible to reach one within a few moments from every home. Ten beautiful, open plats, with an area of 215 acres, are dotted over the city.

Plans for a system of parks and boulevards for Kansas City, Mo., have been prepared. Three parks will be so established and connected by boulevards, that a complete driveway will be created, embracing the entire city. Many suggestions are made in the plans for improving the scenic effects, which, if carried out as designed, will be both elaborate and excellent.

A driveway, nearly a mile in length and twenth-five feet wide, is completed at Krug Park, St. Joseph, Mo. The driveway begins at the entrance of the gate and winds around the hills in such a manner as to make visible to the very best advantage a view of every portion of the beautiful park. A lake will be built on the north side of the park, and appropriations made to complete and protect the work already done.

The reservoir at Herron Hill, Pa., is being transformed into a park. The tract of ground contains about fifteen acres, and is one of the highest elevations in Allegheny county. The grounds will be sodded, walks constructed, and an iron fence will be erected to enclose the park.

The park board at Detroit, Mich., has decided to grade and plant seeds and trees in Medbury Park, this fall, in order to have the grounds ready for ornamentation next spring. The park dedication provides for a fountain in each block, free from cast iron work, which will be water columns, forty feet high, and in all probability there will be electric fountains in five varying colors, forming a very attractive display at evening. The drives at Medbury Park, which have been newly and beautifully paved, are now open to the public.

A scheme, feasible and practicable, has been suggested at Augusta, Ga., by Hugh C. Middleton. The city has no park and Mr. Middleton proposes the plan of converting into a park Greene street, already a beautiful and famous street, because of its straight length, width and wealth of shade of half a century's growth. By placing a railing around it from one end to the other, providing walks both inside and outside of the railing, placing two or three fountains within every square of the street, adding statuary and seats, and employing a gardener and force of hands to care for the grass and flowers, a beautiful transformation would take place.

STREET RAILWAYS.

Surveys have been made at Philadelphia, Pa., for the Westchester and Philadelphia Electric Railway. The line will be twenty-three miles in length.

An elevated electric road will be built at DesMoines, Ia. Surveys have been made, and a charter will be presented to the council, subject to their approval.

A syndicate has been organized to furnish rapid transit to the north side of Chicago and contiguous suburbs by a comprehensive electric railway system.

The board of supervisors at San Francisco, Cal., has passed resolutions providing conditions upon which the board will grant a franchise to any company or corporation to construct and operate street railways along the streets of that city and county.

The newly equipped electric road, extending from Sioux City, Ia., to Morning Side, has been pronounced by J. B. Marsh, representative of the Manhattan Trust Company, to be a splendid piece of improvement, and worth fully $50,000 more than it was in the spring.

More than six miles of street railways, connecting suburban towns with Hazleton, Pa., are in operation and another link of three miles is about completed.

It is proposed at Wheeling, W. Va., to tunnel Reymann's Hill, opposite the head of Sixteenth street, and build an electric road, four miles in length, to Edgington. The improvement will cost $400,000, of which Pittsburgh capitalists will take $300,000 of the stock. This movement will bring within ten minutes' ride of the city 1,000 acres of splendid land at Edgington, which has heretofore been inaccessible.

The employes of the Orange, N. J., Suburban Railway, realizing that the company had been running at a loss and had been reducing all expenses but their wages, called a meeting and agreed to ask for a reduction in their wages until the earnings of the road increased. The offer was accepted by the company and a feeling of harmony and sympathy has been established between employers and employes that will not be disregarded by the company when business becomes good again.

If successful in obtaining a franchise for a bridge between West Duluth and West Superior, Minn., the Duluth Transfer Company will spend $450,000 in building tracks in all parts of Superior. The company has expended in Duluth, so far, $750,000.

MUNICIPAL BONDS.

F. D. Acomb, clerk, Pleasant Ridge, O., invites bids until November 5, for the purchase of $3,000 of five per cent. bonds.

Bids are asked until November 6, by A. W. Miller, Sandusky, O., for the purchase of $7,500 of five per cent. street improvement bonds.

J. H. Pheatt, city auditor, Toledo, O., invites bids until November 6, for the purchase of $7,000 of four and one-half per cent. bridge bonds.

Bids are invited until November 6, by William J. Miller, for purchasing thirty thousand dollars of sewer bonds of the city of Ann Arbor, Mich.

CONSTRUCTION OF SEWERS.

Sealed proposals addressed to the Board of Trustees of the Sanitary District of Chicago and indorsed:

"Proposal for Excavating a Portion of the Main Drainage Channel," will be received by the Clerk of the said Sanitary District at Room H, Rialto Building, Chicago, Ill., until 12 m. (standard time) of Wednesday, the 29th day of November, 1893, and will be publicly opened by the said Board of Trustees at the regular meeting held that day, or at a special meeting called for that purpose.

The work for which the said tenders are invited is the excavation of that portion of the main drainage channel for the said Sanitary District between the east line of Range No. 12, east of 3d P. M., and Corwith, Ill., known as contract sections G, H, I, K, L and M, and consists in all of about 6,534,000 cubic yards of earth.

Each of said sections will be treated as a separate contract in canvassing the proposals and making awards. As all awards will be made by individual sections, each bidder must make prices for each section separate and distinct from every other.

Each proposal must be accompanied by a certified check or cash to an amount equal to $5,000, multiplied by the number of sections bid upon.

All certified checks must be drawn on some responsible bank, doing business in the city of Chicago, and be made payable to the order of the Clerk of the Sanitary District of Chicago; said amount of $5.000 for each section will be held by the Sanitary District until all of said proposals have been canvassed and contracts awarded and signed, the return of said check or cash being conditioned upon any bidder, to whom an award of any portion of said work may be made, appearing within ten days after notice of such award being given with bondsmen and executing a contract with the Sanitary District for the section or sections of said work so awarded, and giving a bond satisfactory to the said Board of Trustees for the fulfillment of the same in the amount of $75,000 for each section of work awarded him.

All proposals must be made upon blank forms furnished by the Sanitary District, and must give the price for each separate item of work.

The bids will be compared on the basis of the Engineer's approximate estimate of quantities, which will be furnished with copies of the specifications.

No proposal will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability to do the work, and that he has the necessary pecuniary resources to fulfill the conditions of the contract, provided such contract shall be awarded him.

Bidders are required to state in their proposals their individual names and places of residence in full.

Specifications and plans may be seen at the office of the Chief Engineer, Rialto Building, Chicago, Ill.

The said Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER,
President of its Board of Trustees.

Attest: THOMAS F. JUDGE, Clerk.

Chicago, Ill., Sept. 27, 1893.

CONSTRUCTION OF SEWERS.

Sealed proposals will be received by the city of Chicago untill 11 a. m. Monday, Nov. 6, 1893, for furnishing all labor and material of every kind whatsoever necessary and laying complete brick and pipe sewers in sundry streets and avenues in the city of Chicago named and located as follows:

SECTION "A."

Warrant No. 17,334—

Wentworth avenue, from Blue Island road to One Hundred and Twenty-first street.

Wentworth avenue, from One Hundred and Twenty-first street to One Hundred and Thirteenth street.

Wentworth avenue, from One Hundred and Thirteenth street to One Hundred and Sixth street.

SEALED PROPOSALS.

Wentworth avenue, from One Hundred and Sixth street to One Hundred and Third street.

SECTION "B."

Warrant No. 17,334—

Wentworth avenue, from One Hundred and Third street to Ninety-ninth street.

Ninety-ninth street, from Wentworth avenue to Stewart avenue.

Ninety-ninth street, from Stewart avenue to Halsted street.

Halsted street from Ninety-ninth street to Ninety-fifth street.

Halsted street, from Ninety-fifth street to Eighty-eighth street.

SECTION "C."

Warrant No. 17,334—

One Hundred and Third street, from Wentworth avenue to Halsted street.

One Hundred and Third street, from Halsted street to Charles avenue.

Charles avenue, from One Hundred and Third street to Ninety ninth street.

Charles avenue, from Ninety-ninth street to Ninety-fifth street.

Ninety-fifth street and Prospect avenue, from Charles avenue to Ninety-fourth street.

Prospect avenue, from Ninety-fourth street to Ninety-first street.

Prospect avenue, from Ninety-first street to Hopkinson avenue.

Prospect avenue, from Hopkinson avenue to Eighty-seventh street.

According to specifications on file in the office of the department of public works of said city.

Proposals must be made out upon blanks furnished at said office, and be addressed to said department, indorsed "Proposals for Constructing Sewers, Eleventh Letting," and be accompanied with $1,000 in money or a certified check for the same amount on some responsible bank doing business in the city of Chicago and made payable to the order of the commissioner of public works for each section as specified above, and persons bidding upon two sections $2,000 and for the entire letting will be required to deposit $3,000 or certified check for same conditioned as aforesaid.

The commissioner of public works reserves the right to reject any or all bids, and to accept bids as applied to each street or section separately, or any number of streets, or to let the whole in bulk, as he shall elect.

Proposals will not be received after the hour above named.

No proposal will be considered unless the party offering it shall furnish evidence satisfactory to the commissioner of public works of his ability, and that he has the necessary facilities, together with sufficient pecuniary resources, to fulfill the conditions of the contract and specifications, provided such contract should be awarded to him.

Companies or firms bidding will give the individual names as well as the name of the firm with their address.

H. J. JONES,
Commissioner of Public Works.

COMPLETION OF UNFINISHED SIDEWALK.

Notice is hereby given that sealed proposals will be received by the common council at a meeting to be held on the 7th day of November, 1893, for the completion of the unfinished sidewalks on First street from Western avenue to Butler avenue. Also for the sidewalks on Fourth street from Baldwin avenue to the west line of Wm. Feighner's addition.

All work to be done according to plans and specifications which will be found on file in the office of the city clerk.

Each bid must be accompanied by a bond of $100, with surety, that if the work be awarded him he will within five days enter into a contract for the performance of the work, and the same properly secured.

The council reserves the right to reject any and all bids.

By order of the council,

GEO. A. TURKEY,
City Clerk.

Marion, Ind.

SOME OF MANY COMMENTS.

INTERESTS THE BRICK CONTRACTORS.

COLUMBUS, O., Jan. 12, 1893.

Editor Paving and Municipal Engineering:

DEAR SIR—The January number of your Journal received. Am greatly pleased with its new form and dress, consider it the best magazine published on the topics it embodies, being full of timely hints and articles of value bearing on my business, which is brick street paving. But this is not the only part that interests me, for I read its entire contents and profit thereby. Yours truly, F. W. CERNY.

A WORK OF ART.

RED WING, MINN., Jan. 13, 1893.

Your magazine certainly is a work of art and does great credit to your institution and to the cause it advocates. Yours truly,

RED WING SEWER PIPE CO.,
C. E. SHELDON, *Sec'y.*

WHERE IT HAS HELPED.

WINONA, MINN., Jan. 12, 1893.

We esteem your periodical highly and it has been of much value to us in reaching a conclusion upon paving, which we are about to enter upon here.

Yours truly, C. A. MOREY,
Chairman Com.

A MODEL NUMBER.

OMAHA, NEB., Jan. 12, 1893.

Please allow me to congratulate you on the January number of "PAVING AND MUNICIPAL ENGINEERING." It's a model number and I trust that the same excellence will be maintained.

Very truly yours,
JOHN GRANT, *Pres.*
Grant Asphalt Paving and Slagolithic Co.

MAY IT LIVE LONG AND PROSPER.

PULLMAN, ILL., Jan. 12, 1893.

I am much pleased with "PAVING AND MUNICIPAL ENGINEERING," in its new dress. May it live long and prosper. WILLIAM LEE.

INTERESTING TO MUNICIPAL ENGINEERS.

BAYFIELD, WIS., Jan. 13, 1893.

The new form is truly a great improvement over the other form. All who are engaged in municipal engineering will hail with delight the contributions found therein. D. F. GLOVER.

THE GENERAL VERDICT.

BINGHAMTON, N. Y., Jan. 12, 1893.

I am much pleased with "PAVING AND MUNICIPAL ENGINEERING." It is very interesting and instructive. Very truly yours,

S. E. MONROE, *City Engineer.*

INTERESTED IN PAVING BRICK.

MT. VERNON, O., Jan. 14, 1893.

I am well pleased with its appearance and as brick paving has come to stay, I eagerly ievour all that is calculated to throw light on that subject.

Very respectfully, A. CASSIL, *C. C. E.*

APPROVED IN ALL RESPECTS.

PHILADELPHIA, PA., Jan. 13, 1893.

The January number of your Journal in its new form meets with our approval in every respect. It is much more attractive and convenient than the old form and we think you will undoubtedly find it a step in the right direction. Wishing you success. Yours truly, CHAMBERS BROTHERS CO.,
J. H. CHAMBERS, *Gen'l Mgr.*

WILL CONTINUE TO READ IT.

MANKATO, MINN., Jan. 13, 1893.

I have received your Journal for some two years and in its new form shall continue to read it.

Truly yours, M. B. HAYNES, *City Engineer.*

THINKS IT A GREAT IMPROVEMENT.

MINNEAPOLIS, MINN., Jan. 14, 1893.

Your handsome monthly in the new form is received. We think it a great improvement on the old style, and the editorial and contributed articles are interesting and valuable for preservation, and in convenient form for binding. Wishing you a large success, we remain, yours truly,

PARKHURST PAVING CO.

BRIEF, BUT GRATIFYING.

TROY, N. Y., Jan. 12, 1893.

We congratulate you.

OSTRANDER FIRE BRICK CO.

LIKE ITS NEW STYLE.

BOSTON, MASS., Jan. 13, 1893.

We are pleased with its "new garments" and typographical arrangement.

POPE MFG. CO.

WILL BE OF MUCH USE.

MOBILE, ALA., Jan. 12, 1893.

It strikes us that you made a great improvement in your magazine and we believe it will be of much use to all parties interested in municipal work.

Yours truly,
IMPROVED WOOD PAVEMENT CO.,
By A. C. DANNER, *President.*

EVEN THE ADVERTISEMENTS ARE IMPROVED.

PHILADELPHIA, PA., Jan. 16, 1893.

To say there is a decided improvement in your magazine is putting it very mildly indeed. The specimen cover published in your December issue was evidence to me of a great improvement in form and taste; to me it is very taking. I was not prepared, however, for the improvements in the inside arrangements. Why, everything is improved—even the advertisements. To tell you all I think about it would seem fulsome. I really am much pleased with it and as to suggesting improvements, why, you have not left me an inch of room.

Yours truly, WILLIAM WAPLINGTON.

CALLS THE ATTENTION OF COUNCIL TO IT.

BOONE, IOWA, Jan. 16, 1893.

I think it just the kind of periodical needed by parties interested in that kind of work, and shall call the attention of the City Council to the matter at its next meeting. Respectfully,

W. W. HIXON, *City Clerk.*

A GREAT IMPROVEMENT.

NEW YORK, Jan. 17, 1893.

New form is great improvement. By judicious selection of best information on construction and maintenance of different kinds of road pavements—Europe is a very important source from which to draw—your paper could become the recognized authority on that subject in America.

Yours truly, RUDOLPH HERING,
No. 277 Pearl St.

MORE CONVENIENT FOR REFERENCE.

MICHIGAN CITY, IND., Jan. 11, 1893.

I like the new form much better than the old as it is more convenient for binding and keeping for future reference. Yours, etc., H. M. MILES,
119 E. 9th St.

ONE OF THE BEST.

FOSTORIA, OHIO, Jan. 17, 1893.

The magazine needs no suggestions to improve it as it already is one of the best published and the form is the best. Yours very respectfully,

FRANK GEBERT.

LIKES THE BIOGRAPHIES.

EVERETT, MASS., Jan. 15, 1893.

I am very much pleased with "PAVING AND MUNICIPAL ENGINEERING" in its new form, especially the short biographies of contributors.

Yours, etc., GEORGE L. MIRICK.